INTERAVIA

REVIEW OF WORLD AVIATION

N.A.T.O. and Atomic Strategy

Price of this issue

U. S. A.:	80 cents
British Isles:	3 s
Switzerland:	Fr. 2.80
Netherlands:	Fl. 2.80
Denmark:	d. Kr. 5.-
Germany:	DM 2.75
France:	Fr. 250
Italy:	Lire 410

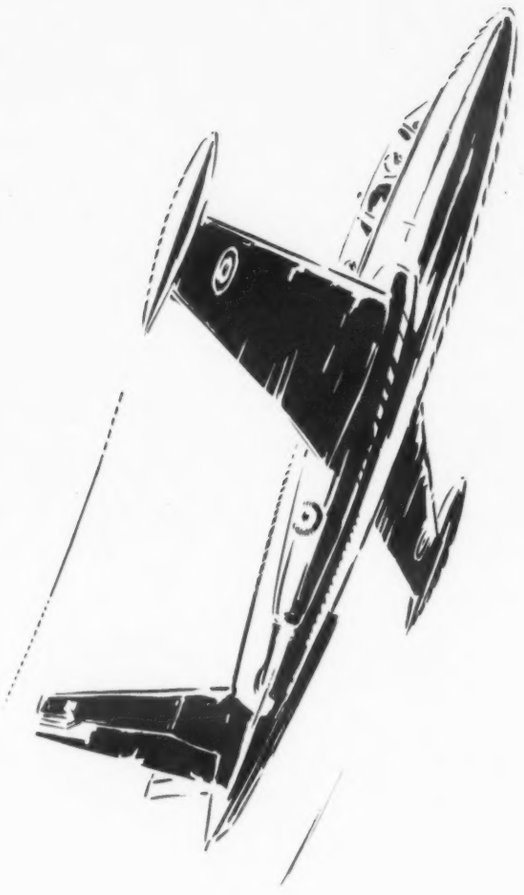
N.A.T.O. ISSUE Nº 1

The West Plans Its Defences

VOLUME IX 7 1954

FOUGA

Magister



ETs FOUGA ET Cie 90 RUE DE MIROMESNIL PARIS

INTERAVIA

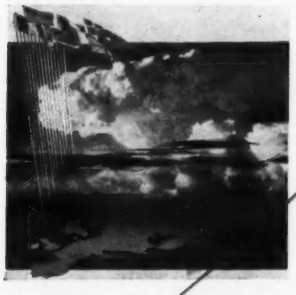
Review of World Aviation

Volume IX | No. 7 | 1954

Editor : E. E. Heiman
Executive Editors : P. A. Blackburn, E. Herzfeld, H. Rieck
Associate Editors : J. M. Stroud, E. Baur, H. Lapierre, Ginés de Bracamonte, F. Sanabria
Art Editor : K. Keller
Circulation : Interavia—Geneva

Contents

N.A.T.O. and ATOMIC STRATEGY—I
Nine Years after Hiroshima 415
N.A.T.O.'s Generals say... 417
Air Force Chiefs' Opinions 418
N.A.T.O.—Link between Old and New Worlds 419
N.A.T.O. Air Forces' Modern Equipment 423
How the Next War will Differ from the Last 426
Effects of Nuclear Weapons 428
America's Atomic Milestones 430
Don't Pin the Air Force to the Ground 431
How the Aircraft Carrier can Meet the Atomic Threat Admiral F. BARJOT, PARIS 434
New Look in Weapons Planning
I—Reducing the Size of Bases 438
II—America's Flying Radiation Police 442
III—The Problem of the Stripped Fighter 443
The Air Hostess Told Us... 446
The A4D Skyhawk 446
Aluminium Celebrates its Centenary J. GUILLEMIN, PARIS 447
Khartoum, Cross-Roads of Africa E. E. WARBURG, LONDON 450
News from the Conference Room 451
What's in the Air ? 452
Book Reviews 454



Front cover .

The West plans its defences.

Two special N.A.T.O. issues — July and August.

Appears Monthly in Four Editions : English, French, Spanish and German.

Advertising Department, Publishing and Editorial Offices, Subscription Department : Interavia S. A., 6, Corraterie, Geneva. Cables and Telegrams : Interavia-Geneva, Teleprinter : 2 21 22. Postal Cheque Account : Geneva I 5380.

✆ **New number : 25 42 34 (five lines)**

Annual Subscriptions : Switzerland, Sw. frs. 28.00 ; U.S.A. and Canada, $7.00 ; Great Britain, £1 15s. 0d. (other Commonwealth countries £2 6s. 0d.) ; France, Fr. frs. 2,400 ; Belgium, Belg. frs. 320.00 ; Holland, Fl. 28,00 ; Germany, DM 27,50 ; Sweden, Kr. 35.00 ; Norway, Kr. 50.00 ; Spain, Ptas 280.00 ; Austria, ö. S. 170 ; Brazil, 230 Cr$; Uruguay, 23 pesos. All other countries : Sw. frs. 28.00.

AGENTS :

Interavia Austria	Postfach 162, Vienna I
Interavia Belgium	5, Heidestraat Noord, Capellenbosch-lez-Anvers
Interavia Canada	21, Hargrove Lane, Toronto 14, Ont.
Interavia France	144, Avenue des Champs-Elysées, Paris 8me
Interavia Germany	Interavia GmbH., Lohausen Airport, Düsseldorf
Interavia Great Britain	Standbrook House, 2-5, Old Bond Street, London, W.1.
Interavia Holland	Henk A. Jansen, Olympiaplein 84 II, Amsterdam-Z
Interavia Italy	30, Via San Marino, Rome 7.23
Interavia South Africa	P.O. Box 6073, Johannesburg
Interavia Spain	Donoso Cortés 85, Madrid
Interavia Sweden	P.O. Box 29, Linköping
Interavia U.S.A.	East Coast : 185 Madison Avenue, New York 16, N.Y. West Coast : 123 N. Gladys Ave., Monterey Park, Calif.

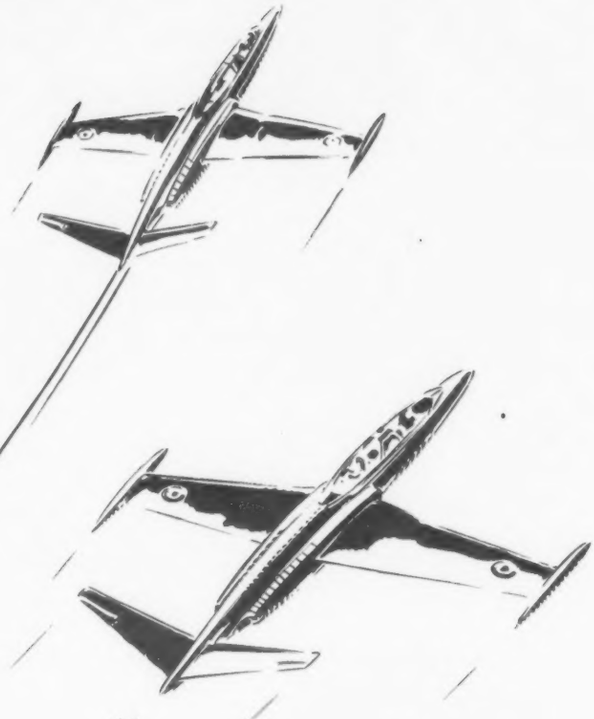
DISTRIBUTORS :

Canada	Wm. Dawson Subscription Service Ltd., 587 Mount Pleasant Road, Toronto 12, Ont. Edward Company Regd., 4720 Ridgevale Avenue, Montreal 26, P. Q.
Denmark	Dansk Centralagentur, Stormgade 20, Copenhagen
Finland	Akateeminen Kirjakauppa, Keskuskatu 2, Helsinki Rautatiekirjakauppa Oy, Köjdenpunojank 2, Helsinki
Ireland	Basil Clancy, Esq., Cooleevin, Foxrock, Co. Dublin
Hungary	Kultura, Akademia-utca 10, Budapest V
Israel	F. Pinczower, P. O. Box 6008, Tel Aviv
Norway	Narvesens Kioskkompani A. S., Box 125, Oslo
Uruguay	Humanitas, Colonia 883, Montevideo
Czechoslovakia	Artia S. A., Smecky 30, Praha II

Copyright 1954 by Interavia S. A., Geneva, Switzerland

Printed in Switzerland

Imprimerie de " La Tribune de Genève ", Geneva
A.G. Fachschriften-Verlag und Buchdruckerei, Zurich

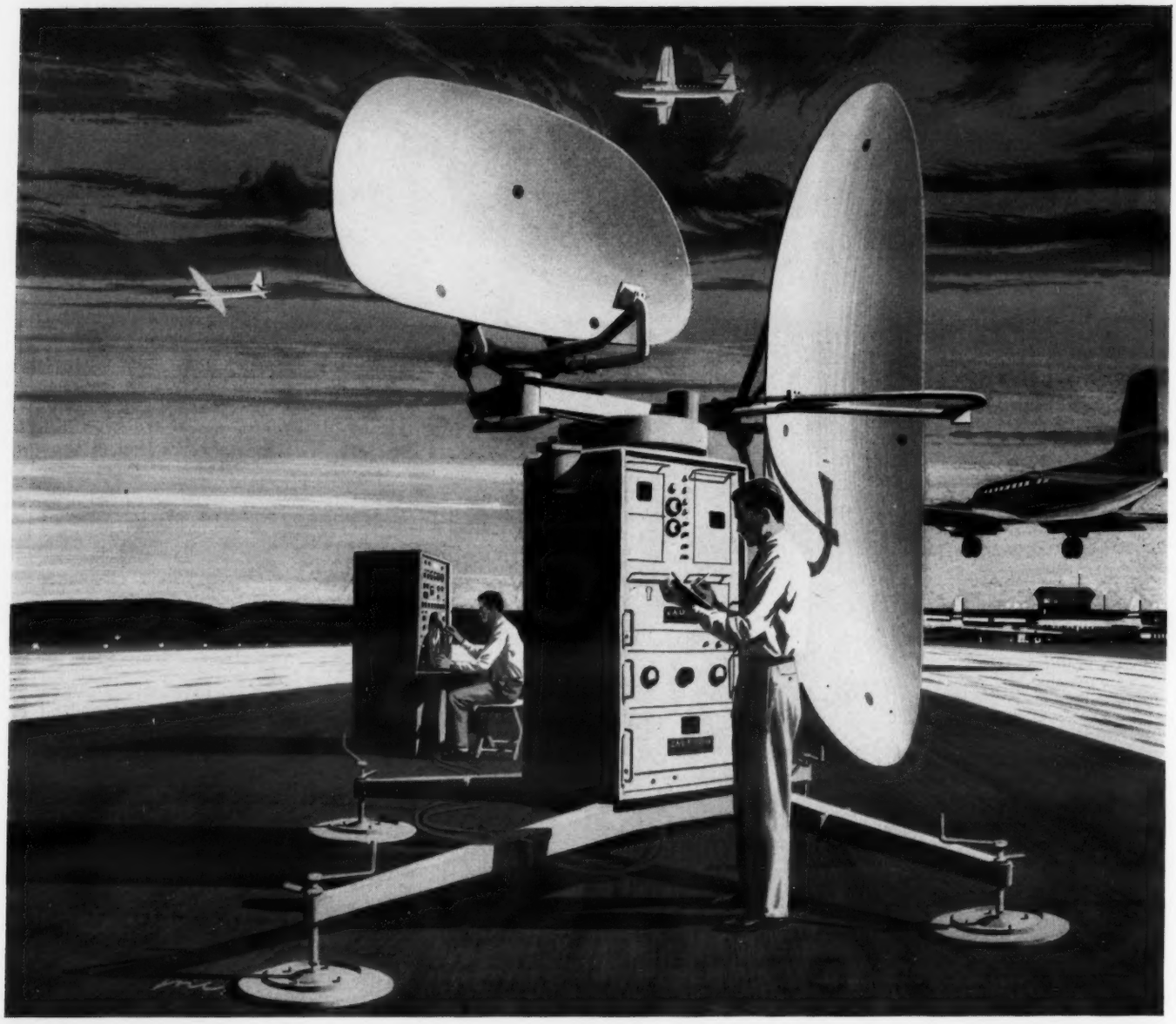


THE ONLY TWIN-JET TRAINER
CHOSEN AND BUILT IN QUANTITY FOR
THE FRENCH AIR FORCE

PROVIDES

70%

OF THE TRAINING OF A
N.A.T.O.
OPERATIONAL PILOT



Gilfillan Announces World's First 4-in-1 Radar

New Gilfillan GCA Quadradar provides Surveillance, Final Approach, Height-Finding and Airport Taxi—four radar functions in a simple one-scope equipment weighing less than 1800 pounds.

For the first time, the complete answer to radar traffic control in one light-weight low-cost equipment—the new Gilfillan GCA Quadradar.

One scope provides four radar functions at the turn of a switch—surveillance, final approach, height-finding, airport taxi control.

Superior to all previous GCA radars in altitude, azimuth and range coverage. The full 30° scan of both azimuth and elevation beams is displayed on the new Gilfillan Beta Scan Azel indicator—and the final approach range extended to 20 miles. The new Beta Azel display combined with height-finding to 50,000 feet in a 20-mile slant range provides advantages never before possible with one equipment.

ONE SCOPE

4 Radar Functions at the Turn of a Switch

1. Surveillance: Sharp presentation of smallest aircraft in 20-mile radius to 10,000 feet, large aircraft in 40-mile radius.

2. Final Approach: New Beta Azel Scope gives precision display in 20-mile sector with 30° azimuth-elevation beam.

3. Height Finding: Accurate altitude information to 50,000 feet at 20 miles.

4. Airport Taxi: Needle-sharp presentation of runways, taxiing aircraft, field obstructions.

TACTICAL ADVANTAGES

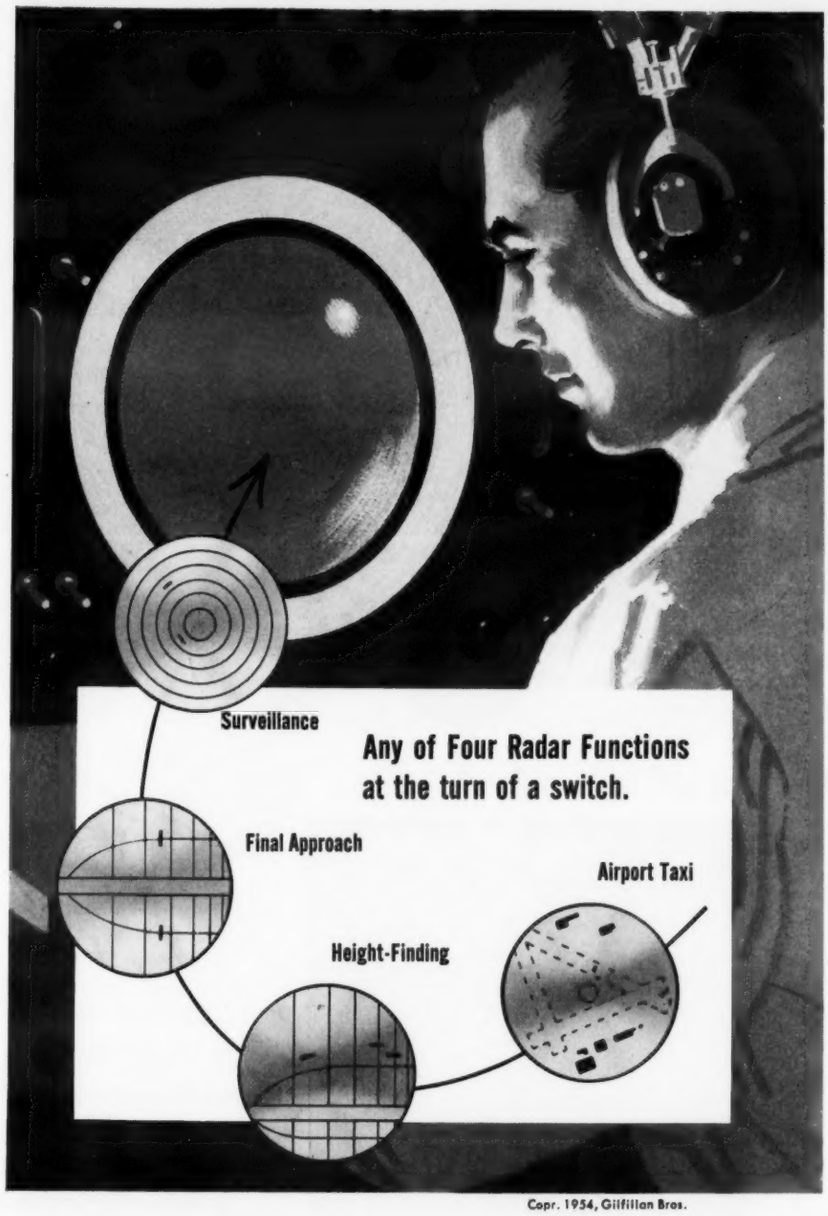
The new Gilfillan GCA Quadradar weighs less than 1800 pounds, is 12 feet high. Air-transportable by cargo plane or helicopter. Assembles for operation within 3 hours; 50-60 cycle operation; weather-protected; remotable up to 10,000 feet. For the first time, complete, efficient radar control is available for advanced emergency airstrips.

WRITE FOR BROCHURE:

Specify:

Gilfillan GCA Quadradar-M (Military Equipment)
Gilfillan GCA Quadradar-C (Civil Airport)

Address Gilfillan Bros., Dept. US-6, 1815 Venice Boulevard, Los Angeles, California, U.S.A.



Copr. 1954, Gilfillan Bros.

MULTIPLE RUNWAY COVERAGE

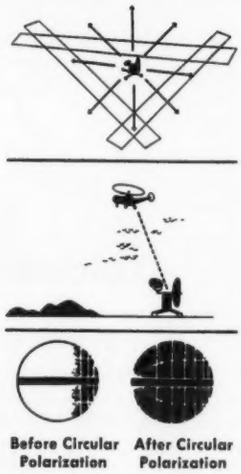
Located near the junction of two or more runways, the Gilfillan GCA Quadradar provides multiple runway coverage without relocating equipment and without expensive turntables. Antennas rotate electrically through 360°, can be set to align instantly with desired runway.

SAFE HELICOPTER LANDINGS

With 30° scan, new Gilfillan GCA Quadradar handles steep-angle helicopter approaches from any direction.

CLEAR, CLUTTER-FREE DISPLAY

X-band throughout, Gilfillan's GCA Quadradar scope presents sharp display. Built-in circular polarization eliminates rain or snow clutter.



Before Circular Polarization — After Circular Polarization

PROVEN EQUIPMENT

It should be emphasized that the new Gilfillan GCA Quadradar is proven practical equipment based on more than 12 years of Gilfillan concentrated experience and research in GCA radar. The Gilfillan GCA Quadradar is composed of Gilfillan-developed components of known dependability, proven in world-wide service and found reliable under the most adverse conditions — plus improvements and refinements based on the experience of 200 Gilfillan field engineers around the world.

Gilfillan **Los Angeles**

50 Watt VHF FIXED STATION

The new Pye 50 watt V.H.F. FIXED STATION is of an advanced design employing the latest techniques. It is ideal for use in normal fixed and mobile schemes where high powered transmitters are required and may also be used for point-to-point radio-telephone links.

A major application is in the aeronautical band where the 50 watt transmitter, together with the standard Pye fixed receiver, provides one of the most efficient ground-to-air control stations at present available in the world.

Telecommunications

Pye (New Zealand), Ltd., P.O. Box 2839, Auckland C.1, New Zealand.

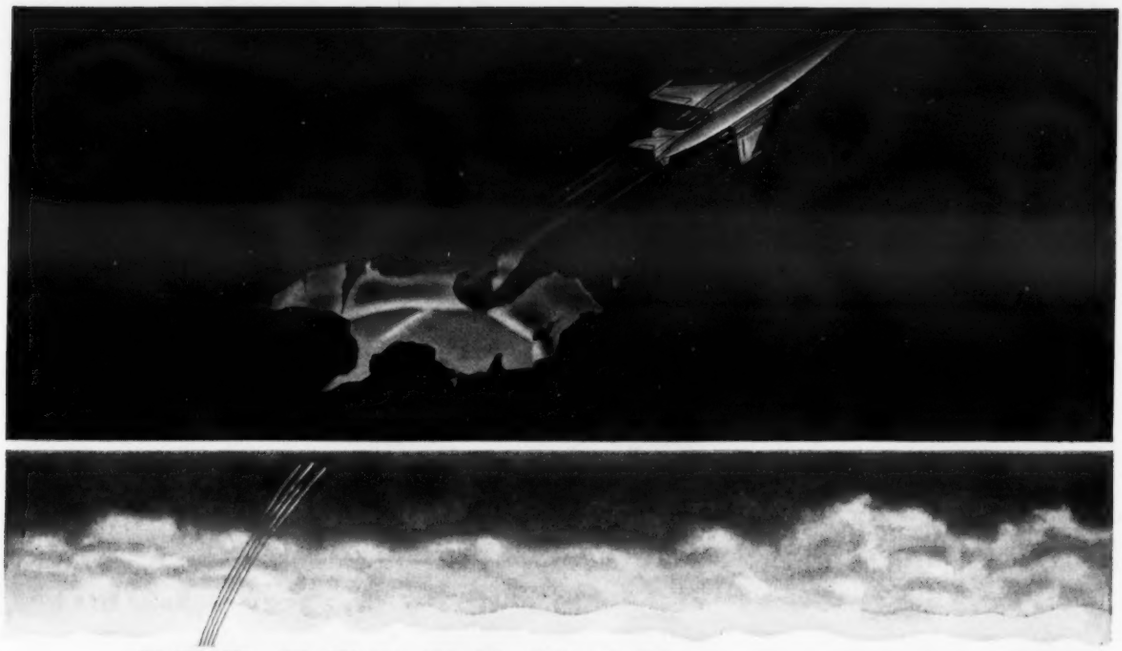
Pye Canada Ltd., Ajax, Ontario, Canada.

Pye-Electronic Pty. Ltd., 65 Park Street, Abbotsford, Melbourne, Victoria, Australia.

Pye Ireland, Ltd., Manor Works, Dundrum, Dublin, Eire.

Pye Radio & Television (Pty.) Ltd., P.O. Box 10648, Johannesburg, South Africa.

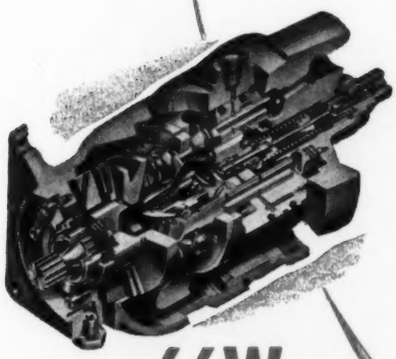
PYE LIMITED • • CAMBRIDGE • • ENGLAND



STRATOPOWER Is Ready for the Planes Which Will Break Through Today's Ceilings

The modern STRATOPOWER Hydraulic Pumps are ready and able to perform efficiently well beyond heights penetrated by piloted aircraft. They've proved it! In Rockets, Guided Missiles and under the simulated conditions of the ionosphere STRATOPOWER Pumps *pump!* They are built to perform at full efficiency and with complete dependability under the extreme conditions and variables imposed by projected speeds and service ceilings.

STRATOPOWER Pumps draw fluid from unpressurized reservoirs to sustain system pressure at altitudes where other pumps, dependent upon pressurized reservoirs, would be unable to supply system demands. Thus, they afford that vital added safety factor for high altitude operation . . . system actuation is assured, even though reservoir pressure may be lost.



SERIES 66W

PRESSURE COMPENSATED HYDRAULIC PUMPS

Designed to simplify hydraulic systems and to render the exacting control of such circuits more dependable. The range of models in these variable delivery pumps includes sizes delivering from 2 to 10 gpm at 1500 rpm with operating pressures to 3000 psi and speeds to 4500 rpm.

There is a STRATOPOWER Hydraulic Pump to provide the efficient source of fluid power for your requirement. Write for full information today.

WATERTOWN DIVISION
THE NEW YORK AIR BRAKE COMPANY
STARBUCK AVENUE • WATERTOWN • N. Y.

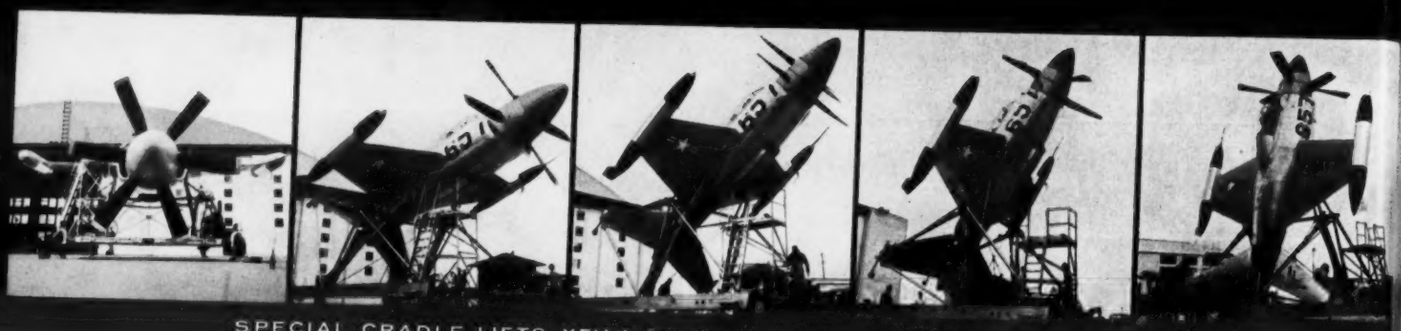
WATERTOWN DIVISION
THE NEW YORK AIR BRAKE COMPANY
710 Starbuck Avenue, Watertown, N.Y.

Please send me full information on STRATOPOWER Hydraulic Pumps.

Name_____

Address _____

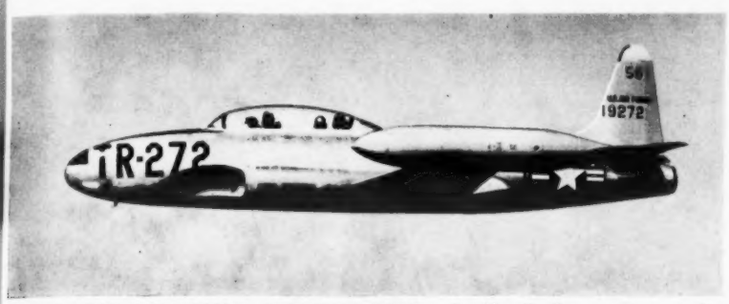
City_____ Zone_____ State_____



SPECIAL CRADLE LIFTS XFV-1 from prone position (for servicing) to upright for vertical takeoff.

Lockheed

LEADERSHIP DEMANDS CONSTANT ACHIEVEMENT



WORLD'S LEADING JET TRAINER, Lockheed's famous T-33, today serves 12 nations in 22 countries. In the United States 9 out of 10 jet pilots receive their training in this dependable high-speed two-place jet trainer.

GUIDED MISSILE and pilotless aircraft research is advancing rapidly at Lockheed. Here engineer-scientists from the Missile Systems Division test top-secret developments to meet problem of supersonic speeds yet unattained.

Scientists Unveil Radical Forms of Flight

High-Speed Navy Fighter Takes Off Straight Up, Lands by Backing Straight Down on Its Tail

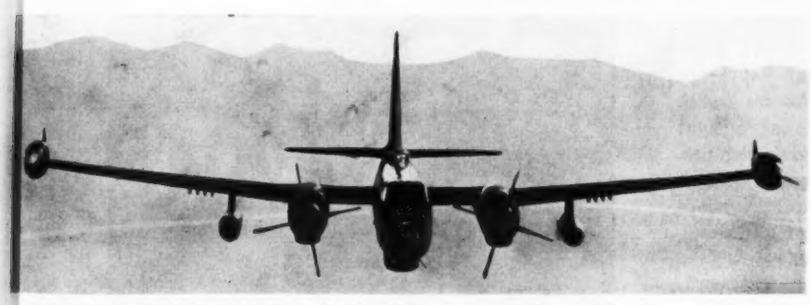
Today's biggest news in aviation is the Navy's XFV-1 built by Lockheed—first successful vertical-rising plane designed on a different concept from the helicopter.

A powerful Allison turbo-prop engine with two jet turbines turning counter-rotating propellers lifts the XFV-1 straight up, rocket fashion. It levels off for speeds in the 500-m.p.h. class, lands on its tail.

Exclusive feature of the Lockheed XFV-1 is its added ability to make conventional takeoffs and landings—very important to pilot training, because it permits flying practice at high altitude prior to the pilot's first tail-down landing.

The XFV-1 makes every open space a landing field, every ship an aircraft carrier. Points to the day when most U.S. fighters may take off vertically from anywhere.

FAMOUS CONSTELLATIONS AND SUPER CONSTELLATIONS ARE THE CHOICE OF 25 WORLD AIRLINES: in the U.S.—Capital Airlines, Delta-C & S Air Lines, Eastern Air Lines, Northwest Orient Air Lines*, Pan American World Airways, Seaboard & Western*, TWA-Trans World Air Lines; in Europe—Air France, BOAC (Great Britain), Iberia (Spain)*, KLM (Holland), TAP Portugal*, Lufthansa (Germany)*; in North and South America—Avianca (Colombia), Cubana (Cuba), LAV (Venezuela), Panair do Brasil, Trans-Canada, Varig (Brazil)*; in Asia—Air India, El Al (Israel), Pakistan International, Thai Airways (Thailand)*; in Africa—South African Airways; in Australia—Qantas Empire Airways.
*Soon in service



FASTER THAN EVER is the Navy's long-range P2V patrol bomber now that it has *two* kinds of power—with jet pods recently added to its turbo-compound engines. Increases its effectiveness in vital shore defense. Photo shows the P2V Neptune flying on jet engines only.

Lockheed

AIRCRAFT CORPORATION

BURBANK, CALIFORNIA, U.S.A.

LOOK TO LOCKHEED FOR LEADERSHIP

NEW FLIGHT FORMS are studied by Lockheed scientists to meet sonic and thermal problems of ultra-high speed, higher altitudes. At Lockheed's Hall of Science each development represents years of research, testing, proving—in man's continual invasion of the unknown.

A Swedish Beauty in the Air

SAAB-91C

SAFIR

The comfortable 4-seat model of the well-known Saab 91 Safir—the Saab 91 C—is especially designed for *executive and pleasure travel.* This modern all-metal aircraft is also equally suitable as a light "utility" or ambulance transport as well as for taxi and feeder use. By removing the rear seats, a quarter-ton cargo can be easily carried. Like its predecessors, the 91 A and the improved 91 B Safir versions now in use with several air forces and government flying training schools, the 91 C Safir can also be used as a *primary trainer* up to the more advanced stage of jet training. All this makes the new Safir one of the world's most versatile light aircraft.

A stretcher case can be loaded into the Safir and the 91 C can also accommodate a medical attendant.

Power ...	one 190 h.p. Lycoming 0-435-A "flat six" air-cooled engine driving a v.p. propeller
Span	10.6 m (34 ft. 9 in.)
Length	7.95 m (26 ft.)
Wing area	13.6 m² (146 sq. ft.)
Weight Empty	745 kg (1,650 lb.)
Gross Weight	1,215 kg (2,686 lb.)
Max. speed	270 km/h (168 mph)
Cruising Speed (Sea Level)	240 km/h (150 mph)
Service ceiling	5,100 m (16,800 ft.)
Normal range	900 km (560 miles)

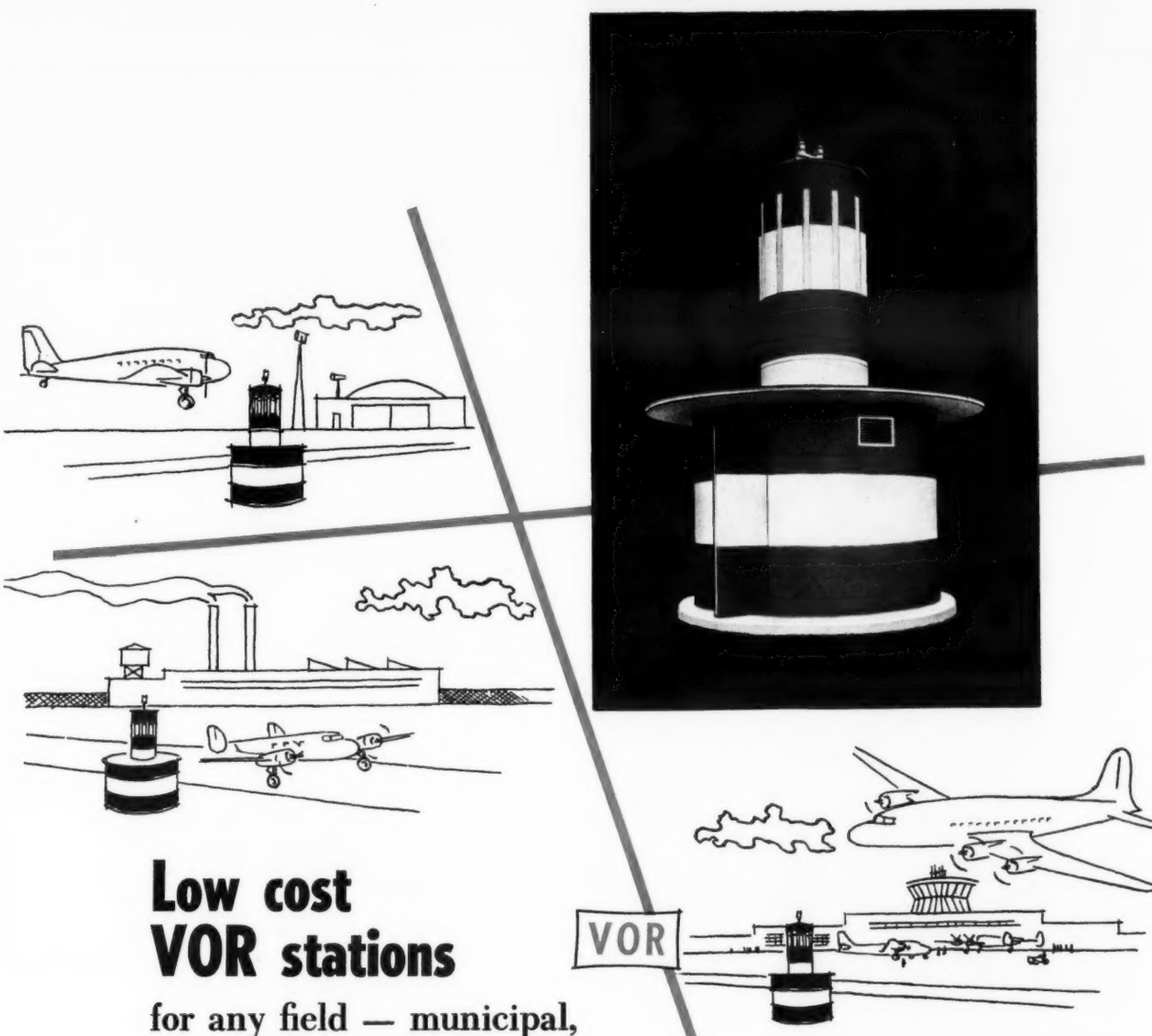
(All figures relate to 1,215 kg (2,686 lb.) weight.)

SAAB

For further information write to

SVENSKA AEROPLAN AKTIEBOLAGET

(SAAB AIRCRAFT COMPANY) · LINKÖPING · SWEDEN



Low cost VOR stations

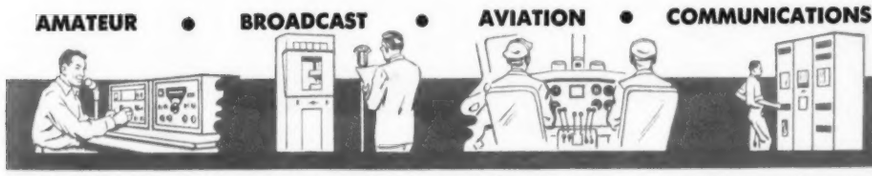
for any field — municipal, commercial or private

Completely dependable, *low cost* navigation-instrument approach facilities are now available to airfields everywhere. Collins easily maintained VOR stations allow airports to increase utilization and permit operations under weather conditions that might otherwise close the field. Internal monitoring systems permit checking of accuracy and operation by non-technical personnel. Collins VOR stations are designed for unattended service and remote control, if desired.

Write today and ask for the free booklet on Collins VOR systems. It will give you all the facts.

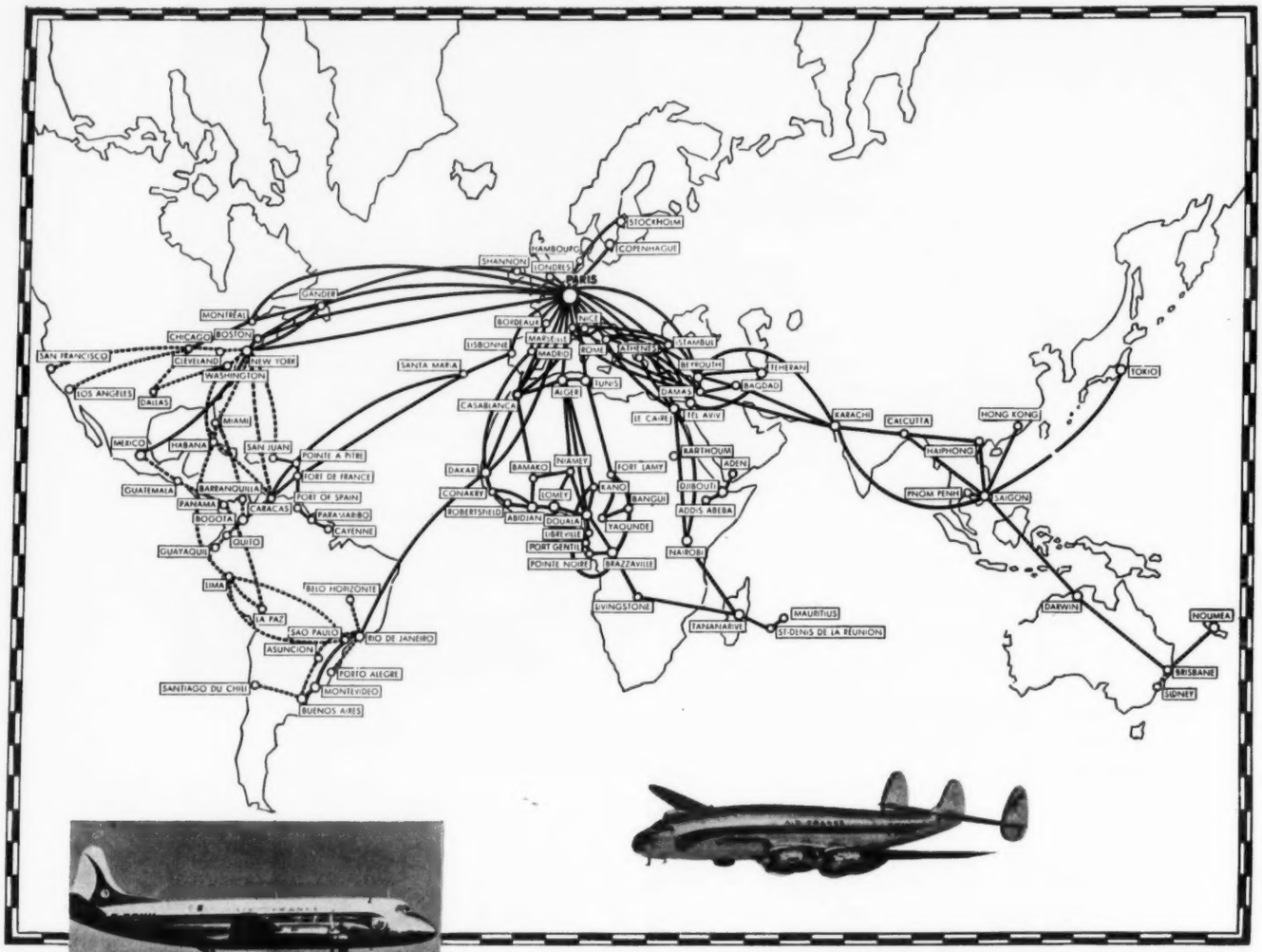
Send for this explanatory booklet today

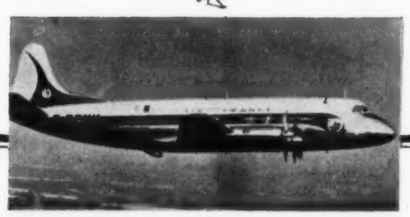
AMATEUR • BROADCAST • AVIATION • COMMUNICATIONS

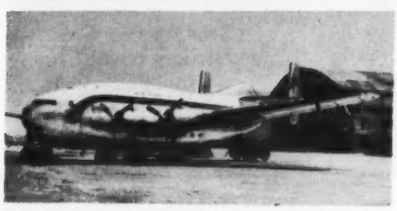


COLLINS

COLLINS RADIO COMPANY, Cedar Rapids 8, Iowa, U.S.A.







AIR FRANCE OFFERS YOU 35 YEARS' EXPERIENCE

For 35 years Air France has had one aim, one ideal : to give all travellers the means of reaching any part of the world with maximum speed and comfort.

Its network is unequalled. Air France has the longest route network in the world, covering 157,000 miles. The company's flag flies to 70 countries and 230 cities. Air France calls at practically all major points in both hemispheres, and adds to them every year.

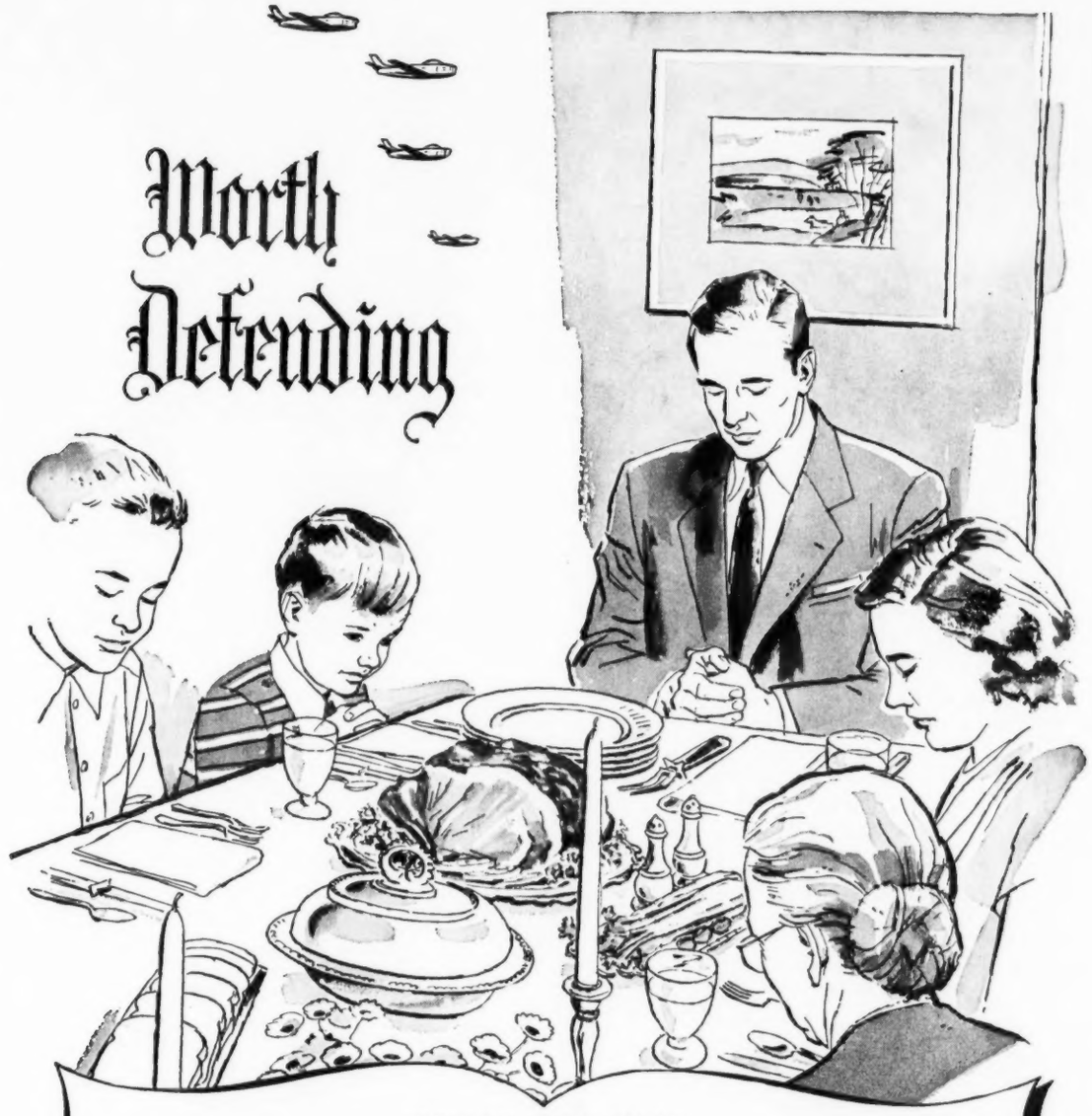
Its fleet is modern. Air France operates " Constellations ", turboprop Vickers " Viscounts ", " Super Constellations ", Bréguet " Deux-Ponts ". These modern aircraft have been chosen for their technical qualities and in order to provide the best possible service on all routes. Thus the New York - Paris route is flown in 12 hours non-stop, and Paris - London in 1 hour 35 minutes.

Its comfort is unrivalled. Air France treats its passengers as V.I.P.s. On its de luxe services it offers not only air-conditioned pressure cabins, reclining chairs, sleepers and even sleeper compartments, but also its famous meals, prepared by master chefs and served by the most courteous personnel in the world.

Its fares are within reach of all. Air France offers prices for every purse : de luxe service, first class, tourist class, off-season rates, special rates for groups, families, etc. Send for particulars.

All travel agencies and Air France, 119 Champs-Elysées, BALzac 70-50, 2 rue Scribe, OPEra 41-00, 30 rue du Faubourg Poissonnière, TAItbout 46-00, 52-02, 53-00 — Paris Air Terminal (Esplanade des Invalides) INValides 96-20

Worth Defending



FREEDOM FROM WANT

Freedom from Want can never apply to a dominated people. History records that any economy built at the price of freedom has always resulted in lowered standards of living . . . and Want is still today the brand on helpless millions.

Freedom from Want is the right of all free people — the goal of every democratic nation. Freedom from Want . . . is *worth defending!*

C-L CANADAIR LIMITED

CANADAIR

— AIRCRAFT MANUFACTURERS —

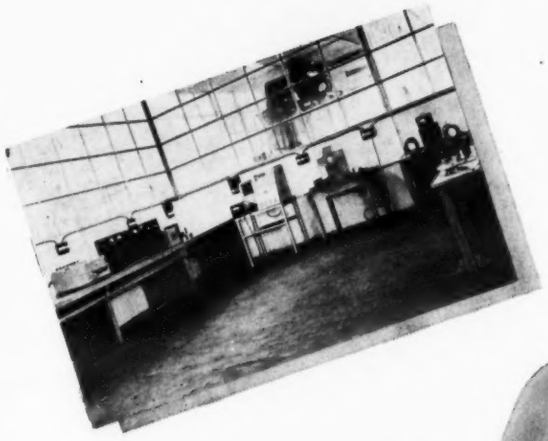
LIMITED, MONTREAL, CANADA

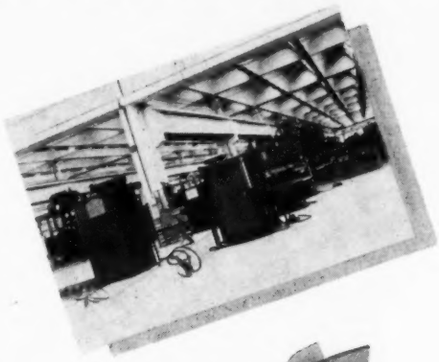
One of a series dedicated to the survival of freedom — Reprints on request. — European Representative, J. H. Davis, Princes House, 190 Piccadilly, London, W.1., England.

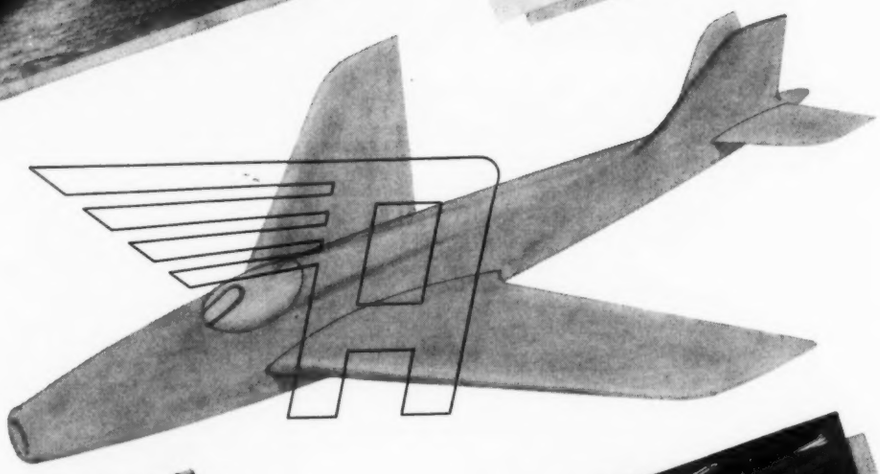
FD: MAURO

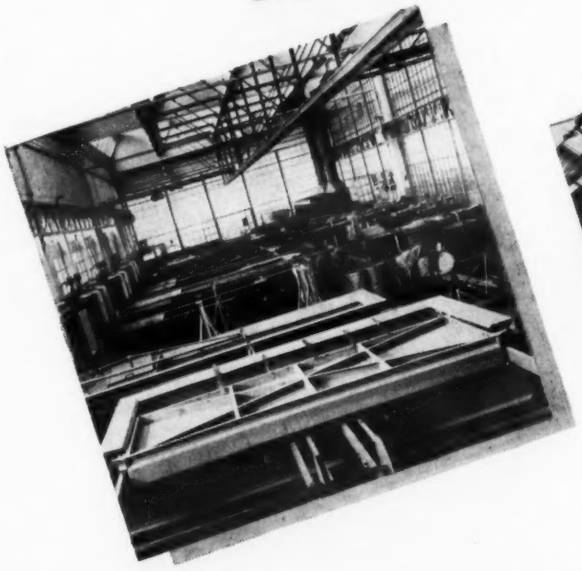
Aerfer

Costruzioni Aeronautiche









POMIGLIANO D'ARCO - NAPOLI -

FOR THE AIR FORCES OF FRANCE AND N.A.T.O.

AIR-EQUIPEMENT

PRODUCES:

Shock absorbers and hydraulic jacks for landing gears

Oxygen regulators and liquid-oxygen installations

De-icers

Electric starters
Cartridge-type starters for gas turbines
Liquid-fuel starters for gas turbines
Compressed air installations
Turbine fuel systems and fuel controls

Autosyns and low-inertia electric motors
Voltage regulators
Radio compasses
Medium-wave and short-wave telecommunications equipment

Gyroscopic horizons
Pressure transmitters and indicators
Turn-and-bank indicators
Magnetic compasses
Rate-of-climb indicators

AE

AIR-EQUIPEMENT

18, RUE BASLY
ASNIÈRES-SEINE
FRANCE

Langelaan & Cerf

BRUSSELS ...

PARIS ...

AMSTERDAM ...

DENMARK ...

MILAN ...

GENEVA ...

Western Europe

equips its aerodromes with

THOMSON-HOUSTON

G.C.A.

CFTH

COMPAGNIE FRANÇAISE THOMSON-HOUSTON

GROUPE ÉLECTRONIQUE

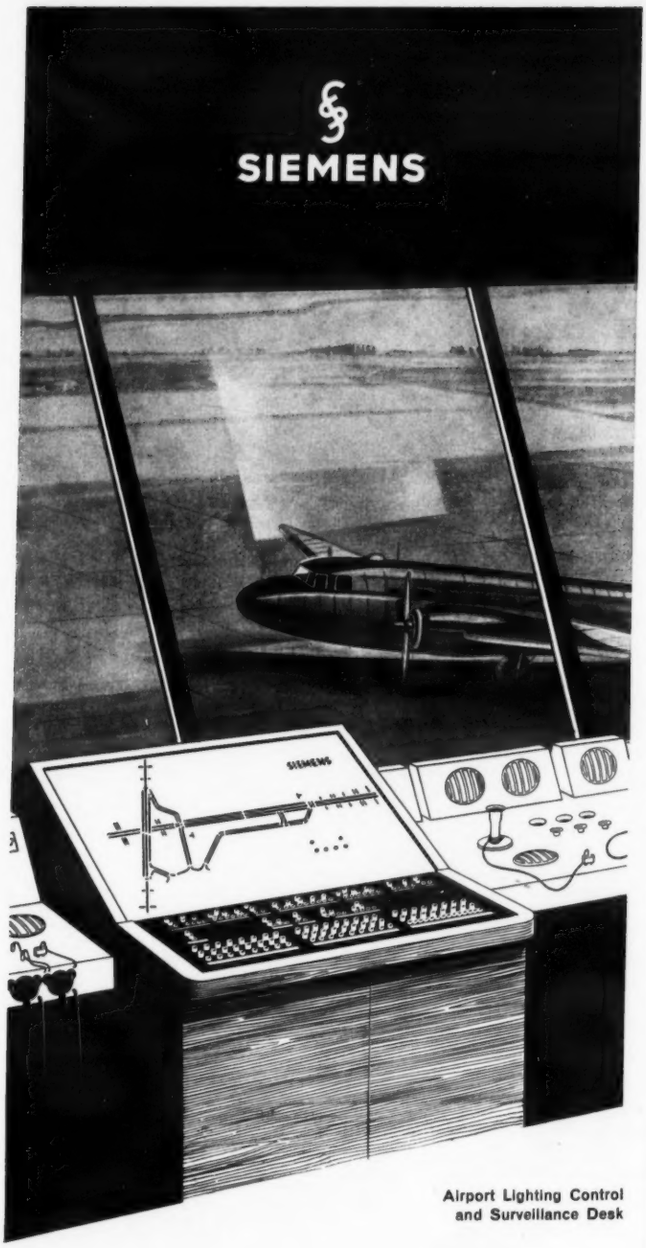
173 Bd Haussmann Paris (8) Tél. ELYsées 83.70 Télégr. ELIHU-42-Paris

FIAT G 82

(R.R. Nene turbojet)

FIAT
DIREZIONE AVIAZIONE
Corso Giovanni Agnelli 200
TURIN (Italy)

SIEMENS



Airport Lighting Control and Surveillance Desk

AIRPORT EQUIPMENT

Approach, runway and boundary lights

Taxi strip lighting, submerged surface lighting, obstruction lights and danger signals

Rotating beacons and traffic lights, wind and landing direction indicators

Apron floodlights, signalling lights, cloud base measuring beam lights

Remote-controlled power supply systems

Refuelling installations

Hangar and terminal lighting equipment and installations

Airfield cables

SIEMENS-SCHUCKERTWERKE AKTIENGESELLSCHAFT

Fourth International Engineering Show

Turin, September 29th - October 10th, 1954

A magnificent Review of scientific engineering progress achieved in Italy and abroad, presented in the following events :

XIVth International Mechanical Fair

VIth International Agriculture Mechanization Exhibition
(including the " Demonstration Days of Mechanized Farming " at the Centro Nazionale, Mirafiori, October 2nd, 3rd and 4th)

VIth International Plastic Materials Show
which this year assumes the rôle of the **First European Plastics Exhibition**

IVth International Cinematographical, Photographic and Optical Engineering Show
Exhibition of Italian and foreign periodicals under the auspices of the Italian Technical and Scientific Press Association.

List of events

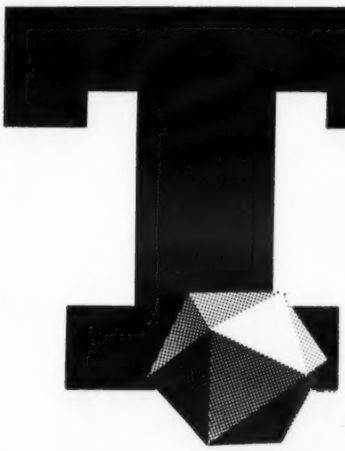
VIth International Plastics Congress
Theme : " Standardization of Plastic Materials " (September 30th, October 1st and 2nd)

Macro-molecular Chemistry Symposium
under the auspices of the International Pure and Applied Chemistry Union (October 1st-3rd)

VIth International Cinematographical Engineering Congress
Theme : " Cinema and Television in Industry " (October 5th-7th)

National Convention sponsored by the " Centre for Technical and Market Research and Assistance " (CRATEMA) to discuss the following subject : " Air Conditioning Techniques for Industrial Plants and Business Premises " (October 8th-10th).

INTERNATIONAL CINEMATOGRAPHICAL WEEK



Daily prizes

Come to Turin ! Reduced railway fares

Representatives Abroad :

NEW YORK	— R. E. STEVENSON - 507 Fifth Avenue - New York 17 N.Y. Tel. Murray 2.2444
LONDON	— Dr. F. PROSIO - Water Road, Wembley, Middx., Tel. Perivale 5651
PARIS	— Italian Chamber of Commerce - 134, rue du Faubourg-Saint-Honoré, Paris VIII - Tel. Elysées 46.27
GENEVA	— " Pondil " S.A. - rue de la Tour-de-l'Ile 1 - Tel. 56.324
FRANKFURT a.M.	— Italian Chamber of Commerce - Feldbergstrasse 24 - Tel. 74.747
BRUSSELS	— G. Brayda - 47, rue de l'Amazone - Tel. 37.72.90

AVIONS HUREL-DUBOIS

ROUTE DE VERRIÈRES A MEUDON, VILLACOUBLAY - FRANCE

BOITE POSTALE N° 6 A MEUDON - TÉL. OBS. 27-90

Look into the advantages of the pneumatic actuation systems devised by

DUNLOP

Designer, operator or service engineer : consider the latest advances in pneumatics before you decide on your actuation system. With the new high-pressure compressed air generating plants specially developed by Dunlop for the latest jet and prop-jet aircraft, pneumatic systems are now being operated at storage pressures of 3,000 p.s.i. through actuators with working pressures up to 1,250 p.s.i. Pneumatic operation is particularly suitable for gas turbine starters and rocket firing mechanisms. A complete range of Dunlop components for actuating all aircraft services is available.

★ ***SAFE — FIREPROOF — CLEAN***

★ ***SIMPLE AND ECONOMICAL TO INSTALL — ONLY A SINGLE RUN OF PIPING***

★ ***LESS WEIGHT***

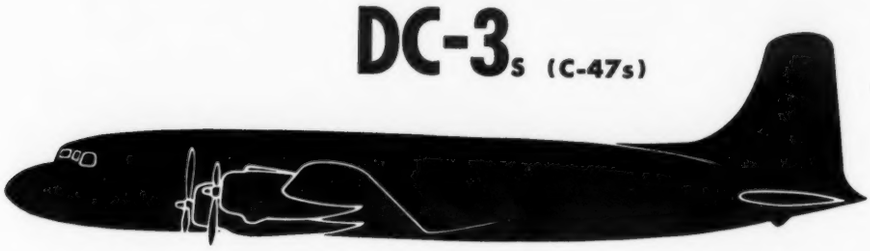
★ ***EASY TO MAINTAIN***

Mark I 3-stage compressor, as illustrated, weighs only 9½ lb., delivers 2½ cu. ft. free air per minute.
Mark II is designed for large aircraft, requires only 20 p.s.i. for supercharging and has a higher altitude performance.

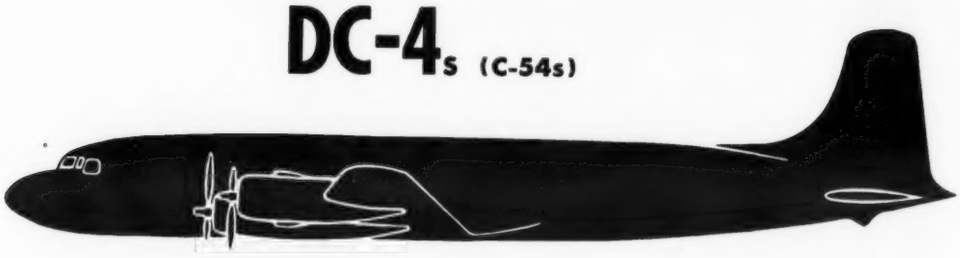
DUNLOP RUBBER COMPANY LIMITED (AVIATION DIVISION) · FOLESHILL COVENTRY · ENGLAND · DEPOTS THROUGHOUT THE WORLD

4X/32

DC-3s (C-47s)



DC-4s (C-54s)



DC-6s (6As and 6Bs)

Prompt delivery of

DOUGLAS SPARE PARTS

Although Douglas has millions of spare parts in stock for all the above airplanes, it is still manufacturing more.

Orders are filled promptly and shipped quickly anywhere in the world.

And Douglas Spare Parts fit and function right.

Your Douglas parts and price catalogs will assist you in ordering your requirements.

Douglas Parts Sales Division, Douglas Aircraft Company, Inc.,

Cable Douglasair, Santa Monica, California, U.S.A.

The Colossus with Feet of Clay . . .

A categorical requirement :

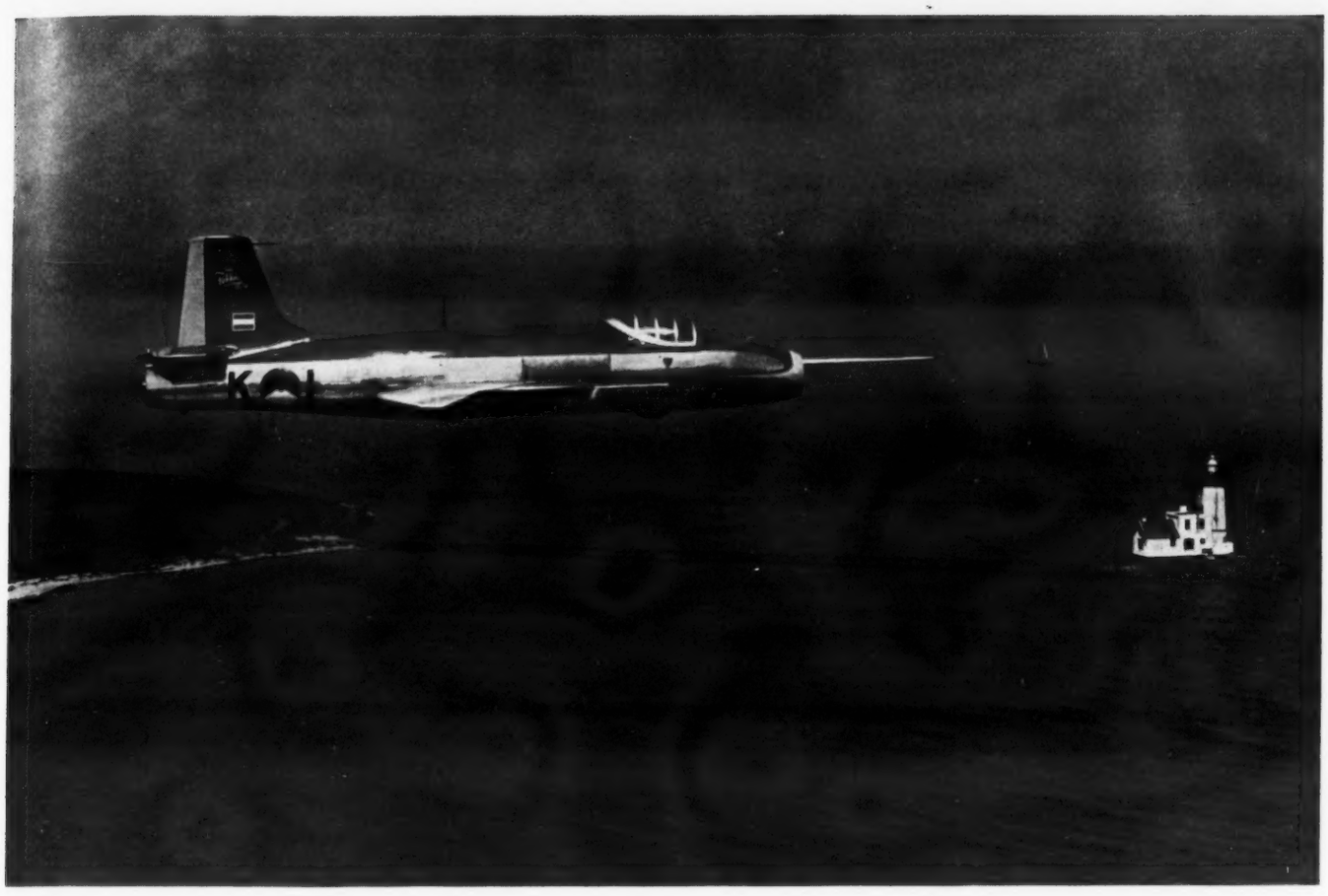
Free the aeroplane of its fatal dependence on the air base !

EST

Etablissement
Sciences Techniques

Vaduz, Liechtenstein
P. O. Box 44462

The solution has been found : the belt-track aircraft undercarriage * The result of 25 years of research and experiment



FOKKER S.14 "MACH-TRAINER"

ROLLS-ROYCE "DERWENT" 8 OR "NENE" 3 TURBINE

The highly specialized FOKKER S.14 "MACH-TRAINER" is an indispensable part of the planned fighter pilot training programs of the Western Air Forces.

The S.14 "Derwent"- and "Nene"-versions have been extensively tested by British, American, Netherlands, French, Italian and other foreign teams and the aircraft has demonstrated its excellent qualities as an advanced jet trainer.

Fokker

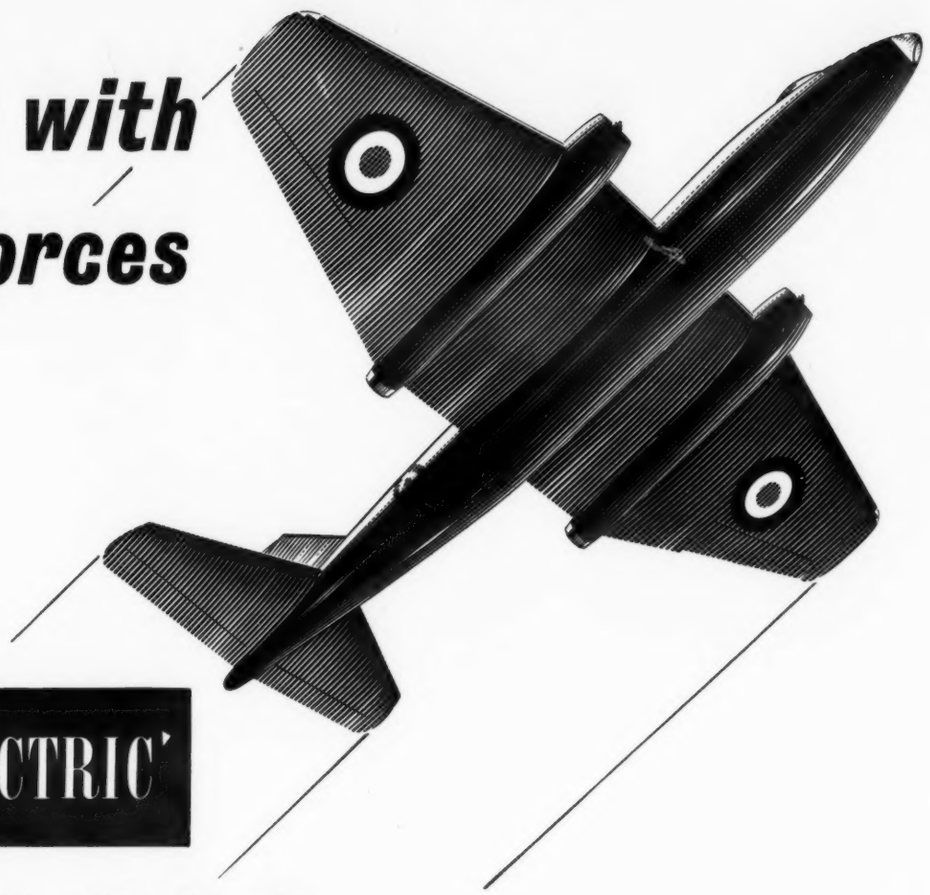
ROYAL NETHERLANDS AIRCRAFT FACTORIES

AMSTERDAM-SCHIPHOL-Z **TEL. ADDR.: FOKPLANES**

PHILIPS

Military radar – Civil radar – Airfield equipment – Communication transmitters – Single sideband equipment – Mobilophones – Portophones – Communication receivers – Link transmitters – Instantuners – V.F. telegraph systems – Private automatic branch exchanges – Automatic public telephone exchanges – Automatic telegraph exchanges.

In service with 4 Air Forces



'ENGLISH ELECTRIC'

Canberra

ROLLS-ROYCE AVON JET ENGINES

The speed, range and altitude performance of 'English Electric' Canberra jet aircraft have been repeatedly proved in a succession of record-breaking flights. The evidence of NATO air exercises also establishes the Canberra as the outstanding aircraft in its field.

In service with
The Royal Air Force
The Royal Australian Air Force
The United States Air Force
The Venezuelan Air Force

In production in 3 countries—
Great Britain
Australia
America
(built under license by the Glenn L. Martin Company as the B57 powered by Wright "Sapphire" engines).

Holder of 12 point-to-point official World Records — 7 in 1953 alone.
Holder of the World's Altitude Record
(powered by Bristol "Olympus" engines).

DESIGNED AND CONSTRUCTED BY **'ENGLISH ELECTRIC'**

THE ENGLISH ELECTRIC COMPANY LIMITED, QUEENS HOUSE, KINGSWAY, LONDON, W.C.2
Offices and representatives throughout the World

Le Vautour

The speed of a fighter
The power of a bomber

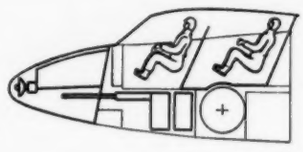
The VAUTOUR is being mass-produced in its three versions for the French Air Force

Comfortably exceeding the speed of sound, it is one of the fastest planes in the world in its category • The ease with which it can be converted permits economical standardization of manufacture and use • It can readily be equipped with any of the most powerful jet engines, such as the ATAR, AVON, SAPPHIRE • Owing to its large capacity and useful load, the VAUTOUR has a long flight endurance (several hours) and can carry a very powerful armament • It can operate from short or makeshift strips.

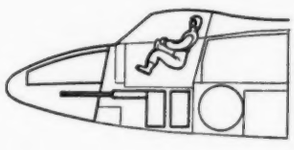
The VAUTOUR is the combat aircraft best suited to European needs

SNCASO

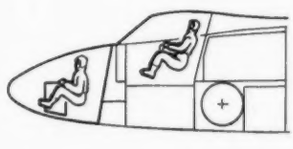
3 VERSIONS



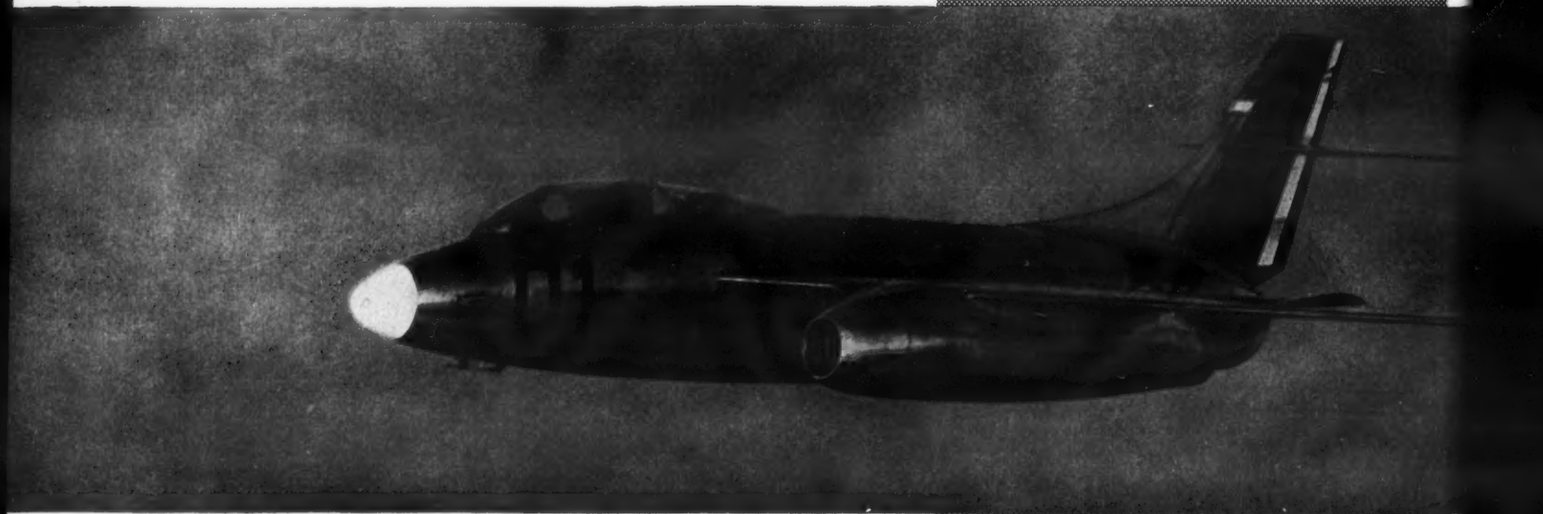
All-weather fighter



Ground attacker



Bomber



SOCIETE NATIONALE DE CONSTRUCTIONS AERONAUTIQUES DU SUD-OU

105, AVENUE RAYMOND-POINCARÉ · PARIS 16e · Tél. KLEber 32-20

INTERAVIA

Deadline Notes

No.7, 1954

ATOMIC WARFARE AND U.S. LAND FORCES

An article by Colonel George B. Sloan in the United States Army "Combat Forces Journal" calls for a radical reorganization of the land forces to adapt them to the use of tactical A-weapons. Personnel strength of divisions should be cut by half, and lighter tanks introduced, so that the new units can be entirely transported by air. The new division should consist of three or more tank-infantry regiments, one atomic weapons battalion and a service support battalion. Total supplies for this unit would run at about 200 tons a day, which could be carried by 20 aircraft.

FRENCH AIR STAFF

Colonel V.B.R. Marias has been appointed second Assistant Chief of the French Air Staff, in succession to Colonel Henri de la Source.

JET AIRCRAFT FOR R.A.F. TRANSPORT COMMAND

Lord De L'Isle and Dudley, British Secretary of State for Air, has announced that the first jet aircraft have been ordered for the Royal Air Force Transport Command. The order is for an undisclosed number of Vickers 1000 transports with Rolls-Royce Conway by-pass engines. According to the Air Minister, they will be capable of carrying 120 fully-equipped troops on stage distances of up to 2,500 miles. The Vickers 1000 prototype under construction at the Weybridge plant will be ready for flight trials in the second half of 1955, so that deliveries of production models will probably not begin for two years.

BRITISH MIDDLE EAST H.Q. FOR CYPRUS

The British Ministry of Defence announces that the joint headquarters of Middle East Land and Air Forces is to move from Egypt to Cyprus "in due course". The headquarters of the General Officer Commanding British troops in Egypt, at Ismailia, will not be affected by the move, which is not expected for some months.

R.C.A.F. STRENGTH

The Royal Canadian Air Force now possesses 2,676 aircraft of 24 different types, Defense Minister Brooke Claxton disclosed at the opening of the R.C.A.F.'s No. 1 Supply Depot near Toronto. By comparison aircraft strength at the outbreak of World War II was 270. Annual expenditure on aircraft procurement ($425,000,000 to $450,000,000) was about 25% of the total Canadian defence budget.

RED AIR FORCE DAY

The fly-past at the annual Red Air Force Day demonstration at Moscow's Tushino airfield mustered about 660 aircraft, including a "beating-wing glider" designed by Alexander Hurievitch Monaskov and a number of MiG-17 jet fighters, which appear to be twin-jet all-weather fighters with radar nose.

P.A.L. DC-6s FOR FRENCH AIRLINES

The French private airlines Union Aéromaritime de Transport and Aigle Azur have each bought a Douglas DC-6B from Philippine Air Lines, following the latter's suspension of overseas operations.

EXPERIMENTAL BRUSSELS-LONDON HELICOPTER FLIGHT

In organizing an experimental helicopter flight from Brussels to London (Sikorsky S-55), Sabena set out to prove that for distances of less than 400 miles the helicopter can provide faster communication, despite its relatively low speed, than the conventional aircraft. Normal flying time Brussels-London (Northolt) 1 hour 20 minutes, plus city centre to airport on both sides 2 hours 10 minutes; total 3 hours 30 minutes. Helicopter: Brussels city centre to London centre 2 hours 45 minutes.

SHORTAGE OF COMMERCIAL PILOTS ...

Air Chief Marshal Sir Guy Garrod, Chairman of the Air League of the British Empire, has submitted a memorandum to the Minister of Transport and Civil Aviation proposing that a £250,000-a-year Government scholarship scheme for training commercial pilots, with exemption from Military Service for all trainees. On the basis of past experience, the project is regarded as an urgent requirement.

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

As at least 70 new pilots are required a year (a figure which is expected to rise to 120 pilots within the next two or three years), training must be offered to about 400 men a year, to make allowance for wastage amongst recruits.

JAPANESE PACIFIC AIRLINES

A special committee, presided over by Shozo Murata, Adviser to the Ministry of International Trade and Industry and President of the Japanese Airport Construction Company, has been set up to create a new airline, Nippon Taiheiyo Koku K. Kaisha (Japan Pacific Airlines Co.). Initially the company is to run about 60 services a year between Japan and South America using two chartered Douglas DC-4s. - The new company may be taking over Japan Air Lines' plans for South American services, which J.A.L. has had to postpone because of financial difficulties.

S.B.A.C.'s 1954-55 PRESIDENT

J.J. Parkes, Chairman and Managing Director of Alvis Ltd., has been elected President of the Society of British Aircraft Constructors for 1954-55.

PYE LTD. INCREASES CAPITAL

Pye Ltd., makers of aeronautical radio equipment etc., have obtained Treasury authorization to raise £700,000 by the issue of 5s. "A" Deferred Ordinary shares, which will be offered to holders of existing shares at a price to be decided in relation to market conditions. Proceeds will be used primarily to redeem £500,000 worth of 4 1/2% unsecured notes and to finance new buildings estimated to cost £100,000.

*

WORKSHOP BRIEFS...

Lockheed announces that the first R7V-2 (Navy Super Constellation) with Pratt & Whitney T-34 turboprops willbe completed early in July. * Kawasaki, of Japan, is working on an improved development, the Kawasaki KAL-2, of the KAL-1 four-seat touring and communications aircraft. A prototype is to begin flight testing in the autumn. * The same firm has also developed a flat-six engine, the Kawasaki KAE-240, of 260 h.p. (3,400 r.p.m.) at sea level. * A new fresh air heater, the MW 65, for heating engines and cabins, is announced by Heizmaschinen-Werken Alfred Kärcher, Winnenden, near Stuttgart. * Sikorsky Aircraft Division of United Aircraft Corp., announces development of a sound muffler for helicopters; about 60% of the noise is absorbed. * Efforts are being made to standardize the warheads of atomic guided missiles, a U.S. Air Force report reveals. The same source mentions advanced work in the field of reconnaissance rockets. * The Douglas A3D-1 twin-jet Navy low-level attack bomber bears the designation Skywarrior. * A number of Short Sturgeon twin-engined target-towing aircraft have been modified, the fuselage nose being shortened and some of the equipment being removed. The modified version is designated Short S.B.9 Sturgeon T.T. Mk.2. * The U.S. Navy has chosen the Beech T-34 Mentor two-seat trainer as standard type for the first stage of pilot training. * The Dassault Mystère IVB-02 jet fighter made its first flight at Melun-Villaroche in mid-June, piloted by Muselli. * During an engine test flight a Fouga CM.170-R Magister recently climbed to the respectable altitude of 40,000 ft. * The Farman Monitor III two-seat civil trainer (SNECMA 170 h.p. engine) also began flight tests in mid-June. * Boeing Airplane Co. announces a new small gas turbine engine, the Boeing 502-10, of 270 s.h.p. max. power. * The prototype of the Boeing Stratotanker/Stratoliner is scheduled to make its first flight during the first few days of July. * AEG has brought out the TG 1500 starter equipment for starting up aircraft engines, charging batteries and use as test equipment. Mobile on three wheels; guaranteed power 500 A continuous, 700 A for 15 minutes and 1,500 A for 1.5 minutes; voltages between 340 and 440 V. * Glenn L. Martin is working on development of a swept-wing fighter-bomber (for Mach 1.8). * Bell announces a project for a new helicopter (40 passengers) with two rotors side by side.

* * *

Nine Years after Hiroshima...

Evolution or revolution in arms and armies?

It is now nine years since the *Superfortress* "Enola Gay" dropped the atom bomb on Hiroshima. Nine years during which the destructive power of the bomb has increased and the stock of atomic weapons grown continually. Since then, world policies—of containment on the one side, of localized conflict on the other—have been founded on the existence of the bomb and its tremendous power of destruction.

Despite its decisive nature, although it has created new conditions of political equilibrium—and although the strategists have long since agreed that it has completely overturned all earlier concepts and conditions of warfare, it is only recently that the military have appeared to take any real interest in the implications of its use. In spite of successive "Bikinis" and "Eniwetoks", armament factories have turned out more conventional weapons, similar to those of the pre-atomic era, than equipment for a conflict in which nuclear explosives might be used on a large scale. As far as can be seen, today's armoured vehicles differ very little from those which rolled off the production lines in 1945. The new aircraft carriers closely resemble their predecessors, and aircraft still need runways which are highly vulnerable to atomic attack. True, there are exceptions. But as a general rule, everything has continued in the armament field since 1945 as if the atomic bomb did not exist. While governments and diplomats founded their policies on the threat it presents, the military, despite the fact that it is they who are responsible for both the use of the atomic weapon and the consequences of such use, clung to the arms, methods and tactics of the pre-atomic age. This is true of the ground forces, whose structure is still the same as ten years ago. It is true of the naval forces, although the aircraft carrier offers a better target to the A-bomb the bigger it is and the more aircraft it houses. It is also true of the air forces. With the exception of the Strategic Air Command which is organized to carry out a retaliatory offensive and which has adapted its equipment and methods to atomic weapons, the other branches of the air arm have remained what they were before Hiroshima. They have even shown a certain retrograde tendency in the face of the demands of the atomic age, by requiring longer and longer runways and incorporating more and more complex engineering developments and hence demanding a logistic support system that is increasingly vulnerable to the blows of the atomic sledge-hammer.

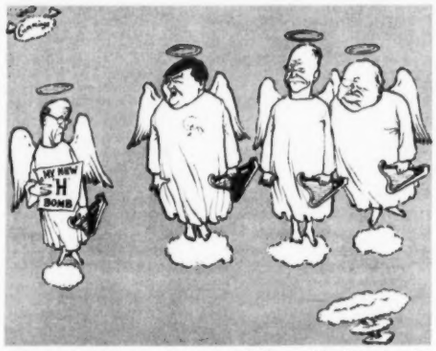
To judge by the unhurried calm of the strategists and the inertia of the engineers, it might be assumed that the atom bomb was to remain a unique phenomenon, and that the West was contenting itself with the means of the past to discourage atomic aggression or, if need be, retaliate to such an aggression. To advance from one doctrine to another, from one collection of arms to another, radically different arsenal, always takes several decades, especially in peace-time when there is no front-line pressure or enemy will to force the modifications necessary to avoid defeat. The military are conservative. Proven solutions seem to them the safest, and their staff colleges never fail to emphasise the timeless quality of the famous "basic principles of war". As for the armament industry, it bases its existence on mass production to pay for its design and development work. Hence the general tendency, if not towards immobilism, is at least towards slow evolution.

If the human race wished to keep pace with its own inventions, it would have to speed up considerably the rate at which succeeding generations take their place in the leading functions of public life. Today the atomic bomb has outstripped the imagination of the men who are entrusted with its use or with organizing the essential conditions for defence against it.

Yet the effects of the atomic weapon are amply known. The United States has not attempted to keep the potentialities of this revolutionary weapon to itself or a few initiated. Although the "Bikinis" and "Eniwetoks" which have succeeded each other almost every year since 1946 are known to us only through the despatches from correspondents and from press reports, the information available is more than sufficient to familiarize the world with the destructive effects of the various sizes of nuclear projectiles. Better still, the famous document of H. D. Smyth (July 1945) and the

Atomic Energy Commission's report "The Effects of Atomic Weapons" (1950) furnish everyone—and for less than two dollars—with all the information they require to organize themselves for atomic war. In addition to these official documents, tons of semi-official and private papers have been written on atomic weapons. Nothing is less secret today than the effects of the atom bomb.

To a certain extent the other side, too, has succeeded in paralysing the rapid evolution which should have taken place here after mid-1945 in the design and use of weapons for the atomic age. The West had thought that, entrenched behind the American atomic monopoly, it had all the time it needed progressively to adapt doctrine and armament of the armed services to the requirements of the new era. The various localized conflicts have shown, however, that this concept was unfounded and that the atomic breastplate has its faults. Moreover, because they were localized, these conflicts necessitated the employment of conventional armament, of military methods and organizations close to those of the past. It has been proved today that even the United States cannot provide itself with the equipment for a conventional war and at the same time rapidly develop armed forces capable of meeting the atomic threat which would accompany a general war. The adaptation of weapons and tactics to a definite type of conflict and a given theatre of operations appears more than ever imperative. This fact has emerged recently in Indo-China, and before that in Korea. Thus in the present situation the two blocs are constrained to equip themselves simultaneously with both types of armament: one for localized conflicts, the other for atomic warfare. The Eastern bloc's advantage is that it holds the initiative and that it operates via "individuals" placed in strategic positions and playing on Communist ideology to provide the troops for its local conflicts. And the danger is that, in the field of armed forces as in air navigation, there is a "point of no return". Once composition and armament of these forces have been adapted to atomic destruction, it will be very difficult for them to play their part efficiently if nuclear weapons are not used. Similarly, if they retain their classic organization and equipment, they will be too vulnerable to the atomic weapon. The dilemma is a serious one and explains to a certain extent why a sudden revolution has been replaced by a slow evolution of the old military machine which still exists today on both sides of the Iron Curtain. For several months past there has been talk in the West of a "New Look". The free world has suddenly tried to speed up the natural evolution so as to adapt the organization and armament of its forces to the menace that has been hanging over them for a number of years. However, not everyone has welcomed the "New Look" with the same fervour. Nobody, of course, denies that planning must take the atomic weapon into account. All agree on the principle. It is on methods that divergent opinions come to light. The navy fears that having already condemned the battle-ship, the atom bomb will also sound the death knell of all heavy vessels, including the atomic aircraft carrier. The army, particularly in the United States, sees in it an excuse for the reduction in its appropriations in favour of the air force. The latter, though conscious of its offensive strength, is worried about the serious drawbacks of its ground organization. Hence all approach the implications of the atomic age with caution. Yet, now that American, British and Russian factories are turning out fissionable material or thermo-nuclear products, the stock of projectiles must grow not only regularly but at a noticeably greater speed. It is high time that strategists, engineers and military should attack the problem set them by their governments and their teams of scientists.



"There! I told you to stop fiddling with that bomb, Comrade Professor."

—Cummings, "Daily Express", London.

Is a revolution essential? Or is it sufficient to adapt the existing arsenal and the conventional combat equipment? These are questions that must be answered, particularly in the air sector, since this is more decisive than any other. What do the new ideas of strategists and staffs mean for the air force? What equipment is needed and what engineering developments should scientists and engineers pursue? Does this equipment exist already in one form or another, or must it be created from scratch? What can be conserved from today to defend tomorrow? Or what must the West design today in order to be strong the day after tomorrow? Must technical developments, methods of employment, procedures, organizations be completely recast or merely progressively modified? Such are the problems on which the present issue sets out to throw light, to provide a basis for discussion, since there can as yet be no question of supplying solutions and even less *the* ideal solution. But all will surely agree that the time has come to encourage reflection on the multiple aspects of air power in the "atomic age".

E. E. H.

The second A-bomb to be dropped "in earnest" by the Americans in the last days of World War II fell on the thriving industrial city of Nagasaki, Japan. The right-hand photo shows the main area of devastation, with the concentric circles marking off 1000-yard distances from "ground zero", the point of detonation.

The effects which a modern H-bomb of the type that obliterated Elugelab islet in the Marshall Islands in autumn 1952 would have on Washington, D.C., capital of the U.S.A., is illustrated in this drawing. Shaded portion shows the three-mile radius in which destruction would be complete, with the U.S. capitol as "Ground Zero". Furthermore, the detonation would cause lesser damage out to a radius of seven miles and light damage as far as ten miles.

NATO's Generals Say...

General Lord Ismay,

Secretary-General, North Atlantic Treaty Organization

"We are now entering upon a difficult phase. The military danger may appear to have receded. The Soviet will continue to do their utmost to divide us. The longer you carry a load, the heavier it seems to become, and all the member nations have been carrying a very heavy load of defence expenditure for a very long time. Nevertheless, the threat remains, and it would be a mocker of all the exertions and sacrifices that have been made if we were now to be complacent or to relay or worse still to fall apart. We are on the right road: our fate is in our own hands. If we are true to ourselves and to each other, and if we remain united as we are today, we will avoid the unspeakable horrors of a third world war . . ."

General Alfred M. Gruenther, U.S. Army,

Supreme Allied Commander, Europe

"There are now between 90 and 100 divisions for the defence of Europe . . . Some are ready on D-Day, some on D plus 15, others on D plus 30. With respect to air power, the increase has probably been even greater ... We are now engaged at S.H.A.P.E. in working on the philosophy of war projected some three years in the future, and we visualize that we would use atomic weapons in the support of our ground troops, as well as atomic bombs on targets deep in enemy territory . . . We have long-range aircraft to which the Soviet now have no answer. Supposing this war should take place this year, 1954, our conclusion is that the Soviet Union would be defeated in every sense of the word—even though there might be no winner in an atomic war . . ."

Major General Warren R. Carter, U.S.A.F.,

Commander, Allied Air Forces, Northern Europe, Sandvika, Norway

"We are working at this time with limited means: our forces are small . . . but their strength will increase steadily . . . Here I want to stress that in Allied Air Force Northern Europe we think of Norway and Denmark as one area to be defended, though the two countries must rely primarily on their own resources to create a hard core of defensive strength in the Northern Command. We must face the fact that even the air strength which we expect to have on completion of plans will be limited by manpower and resources, and we might find ourselves hard pressed to defend our territory against an all-out enemy effort. However, since this applies more or less to any single N.A.T.O. nation, the N.A.T.O. concept is that of a single, mobile defensive force shielding a single area composed of the 14 member nations: a force that can be deployed so as to protect the most vulnerable spots in the area as a whole. Air power, because of its flexibility, is extremely important to the execution of such a concept. In our planning we are constantly in contact with the sources of outside help, that is, with the Supreme Allied Commander, Atlantic; S.H.A.P.E.; Allied Air Forces Central Europe; Britain's Bomber Command and the United States Strategic Air Command . . ."

General Lauris Norstad, U.S.A.F.,

Air Deputy, Supreme Commander, Allied Powers, Europe, Paris

"I feel no barriers of language, of uniform, or of customs. We have contributed something, both material and spiritual, to the foundation on which our countries may continue to work toward the objectives of peace and freedom of the world. I am confident that this command has both the will and capacity to meet the challenge of the future . . ."

Lieutenant General Lawrence C. Craigie, U.S.A.F.,

Commander, Allied Air Forces, Southern Europe, Naples

"What we are aiming for in Southern Europe is an Air Force with sufficient strength and skill to defend successfully the area against air attack. This force must possess sufficient versatility to be able to launch an immediate counter attack to gain and hold air superiority for our N.A.T.O. forces. We must reach this goal at a cost in money and manpower that is within the economic capability of the nations concerned. Even if we are never called upon to use this international military force we are building—and we all hope fervently that we will not have to use it—I am confident that this intermingling of people and ideas will do much to eliminate the enmities of the past. That end alone will more than compensate for the time and effort and expense that have gone into the building of a military machine for the common defence."

Air Chief Marshal Sir Basil Embry, R.A.F.,

Commander, Allied Air Forces, Central Europe, Fontainebleau

"It will be my aim to continue building up the efficiency of this force to a pitch where it will be the dominating force in Europe. Should we go to war—which God forbid—the air forces of Central Europe should be the battle-winning potential for that struggle . . ."

N.A.T.O.

Air Force Chiefs Reply...

"What changes in the offensive and defensive air arms do you anticipate as a result of the general adoption of nuclear weapons?"

This is the question which *Interavia* put to a number of Air Force Chiefs and senior air officers, and here are their replies.

General P. Fay,
Chief of Staff, French Air Force

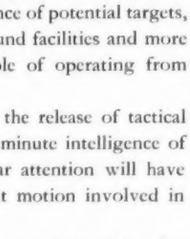
"Special attention must be paid to the following two points in considering the use of nuclear weapons by the Air Force:

— an isolated bomber will be at least as dangerous as a mass raid of 1945;
— any important target will therefore be excessively vulnerable.

There results:

— the necessity of building up air defences capable of detecting, intercepting and destroying every enemy aircraft, operating singly or otherwise;
— the necessity of reducing to a minimum the importance of potential targets, by protecting, camouflaging and dispersing all ground facilities and more particularly by reverting to light air units capable of operating from makeshift bases;
— the necessity of developing maximum accuracy in the release of tactical nuclear weapons, which will require complete last-minute intelligence of the location of troops on the battlefield. Particular attention will have to be given to this aspect in view of the constant motion involved in land warfare;
— the necessity of imparting the greatest flexibility to aerial action: for this purpose the widest possible range of aircraft capable of delivering nuclear weapons must be made available."

General Aldo Urbani,
Chief of Staff, Italian Air Force



"More important even than modifying today's aircraft for their new rôle of nuclear weapons carriers will be developments to improve navigation and sighting methods by the ever increasing use of electronic equipment.

Furthermore, the layout and organization of present-day air bases must be radically modified. Their heavy cost, the vital importance of buildings and installations, and the enormous length of the runways mark them as first-class targets for atomic attack.

Combat aircraft will have to be dispersed to a much greater extent by making them less dependent on their fixed bases and by increasing the number of bases, particularly makeshift reserve bases.

The defence of the bases must also be improved. This means that the installation of continously improved electronic surveillance and warning equipment is of paramount importance.

Chief of all, the fundamental criterion of the efficacy of the modern air arm will be the rate of incessant improvement, its mobility and its flexibility."

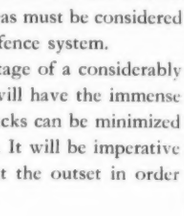
Lieutenant-General A. Baretta,
Chief of Staff, Royal Netherlands Air Force

"Atomic weapons give the air arm considerably greater destructive power. While there is no reason to expect immediate fundamental changes in the offensive air arm itself, the methods of employing the air arm will change considerably. Mass attacks executed in W.W.2 will not be needed any more. Neither will the defensive air arm be subjected to fundamental changes, but the demands for effective air raid precautions are considerably greater. Altogether a modern air defense system must be 100-percent effective.

History teaches that invention of better offensive weapons is immediately followed by development of still better means of defense. Great progress is being made in increasing the effect of offensive and defensive weapons, thanks largely to recent advances in the field of electronics. For instance, improvements in radar interception will make it more and more difficult to penetrate well defended areas. Effective air raid precautions for the defense of the civil population and dispersal of the industrial areas must be considered as the final link in the chain of a well prepared air defence system.

In a future war both opponents will have the advantage of a considerably increased air striking power. However, the aggressor will have the immense advantage of surprise attacks, but the effect of such attacks can be minimized by effective warning systems and by quick interception. It will be imperative to avoid destruction of one's own offensive air arm at the outset in order to be ready for retaliatory action."

Air Chief Marshal Hon. Sir Ralph A. Cochrane, ret.,
Vice-Chief of Air Staff, R.A.F., 1950—52



"The 100 years up to 1945 witnessed a steady growth in the power of all weapons of war, without however introducing any lasting change in the balance between offence and defence. But the first atomic explosion blew this balance to pieces and set the defence a task which it was quite unprepared to meet; for instead of succes being achieved when an attrition rate of some 6 % could be inflicted on an attacking bomber force, it became necessary overnight to envisage defensive systems immune from penetration, and that clearly is far beyond anything so far contemplated.

Moreover, such developments as are in sight point in the direction of still greater offensive power, while new methods of propulsion, and the development of new material seem likely to aid the offence rather than the defence, at least until the defence develops a weapon with an effective range comparable to that of the attacker. Furthermore, quite outside the technical field, the offence has the initiative and, if intelligently handled, can introduce tactical situations which cannot fail to embarrass any practicable scale of short range defence likely to be available on the outbreak of war.

So at present and for as far ahead as one can judge the offence is likely to remain on top, with a striking power so great that no government could willingly permit its country to be subjected to it. It may therefore be suggested that the atom bomb has neutralised itself, and that air power will come to be seen as no more than a brief interlude in the long history of war, which will once more revert to campaigning on land and at sea. I find it hard to believe that this can be true, because once major war has been joined and vital interests are at stake, it may be impossible to resist calling on the atom bomb if the alternative is national disaster. For that reason I believe that the atom bomb will continue to dominate peace as well as war and that although every nation will strive to find a means of defence against it, the possession of atomic weapons, and the means of delivering them, provides the best guarantee against attack, and therefore the best prospects for peace. The atom bomb may well provide an element of stability which would not be present if offence and defence were nearly balanced, for then a country might be tempted to gamble on a lightening win before it could itself receive any serious harm."

N.A.T.O. – Link between Old and New Worlds

The N.A.T.O. flag in front of the Palais de Chaillot, Paris, headquarters of the North Atlantic Treaty Organization in Europe.

Why America spends money on Europe

Marshall Plan, Organization for European Economic Co-operation, Brussels Treaty, North Atlantic Treaty, Mutual Assistance Programme, Council of Europe, European Coal and Steel Plan, European Defence Community, Balkans Pact . . . Although, or perhaps because the man in the street assiduously reads the papers, he has the anxious feeling that he can't keep up with it all.

Yet, without over-simplifying, it is possible to assure the worried newspaper reader that all these complicated names can be reduced to a common denominator. Fundamentally they are not dozens of different agreements, but links in a single system—that this system does not always run absolutely smoothly is beside the point. All these pacts and organizations serve one end, which General Dwight D. Eisenhower outlined in simple terms early in 1951, when he assumed his appointment as first Supreme Allied Commander Europe[1]:

"*What is the importance of Western Europe to us? There are, of course, ties of sentiment; they are the people from whom we drew originally our genius, our blood stream; they are our own relatives, and there are other bonds beyond those of sentiment that appeal to us in this job of protecting ourselves. We must look at all the common factors.*

First of all in Western Europe there exists the greatest pool of skilled labor in the world. In Western Europe exists a great industrial fabric that is second in its capacity only to that of our own nation. There are more than 200 million people who are related to us. If we take that whole complex with its potential for military exploitation and transfer it from one side to another side, the military balance of power has shifted so drastically that our safety would be gravely imperilled . . . The significance of the Western European group of nations to us is even greater than that. They have with many areas of the world close blood, political and economical ties. It is scarcely possible to imagine the fall of Western Europe to communism without the simultaneous fall of certain of these great areas, particularly those, and first those, areas which have a political dependency upon the European powers, the very areas from which we draw the materials which are absolutely essential to our existence . . ."

Eisenhower then passes on to more detailed points. He sketches the basic tasks of the North Atlantic Treaty Organization, describes the immediate reasons for the establishment of Supreme Headquarters Allied Powers Europe in Paris:

"*Nobody can defend another nation. The true defence of a nation must be found in its own soul, and you cannot import a soul. We must make sure that the heart and soul of Europe is right. That is one of the obligations that is imposed on me and my staff. I cannot conceive that the United States ever consented to accept the responsibility for acting in Western Europe except with those two reservations, that their representatives would do their utmost to see that the United States was not being made merely an Atlas to carry the world upon its shoulders.*"

These words of Eisenhower's not only explain the essence of the North Atlantic Pact, but also show what is behind the whole complicated system: *an American-European defensive and industrial alliance based on political, military and economic co-ordination of Western Europe.*

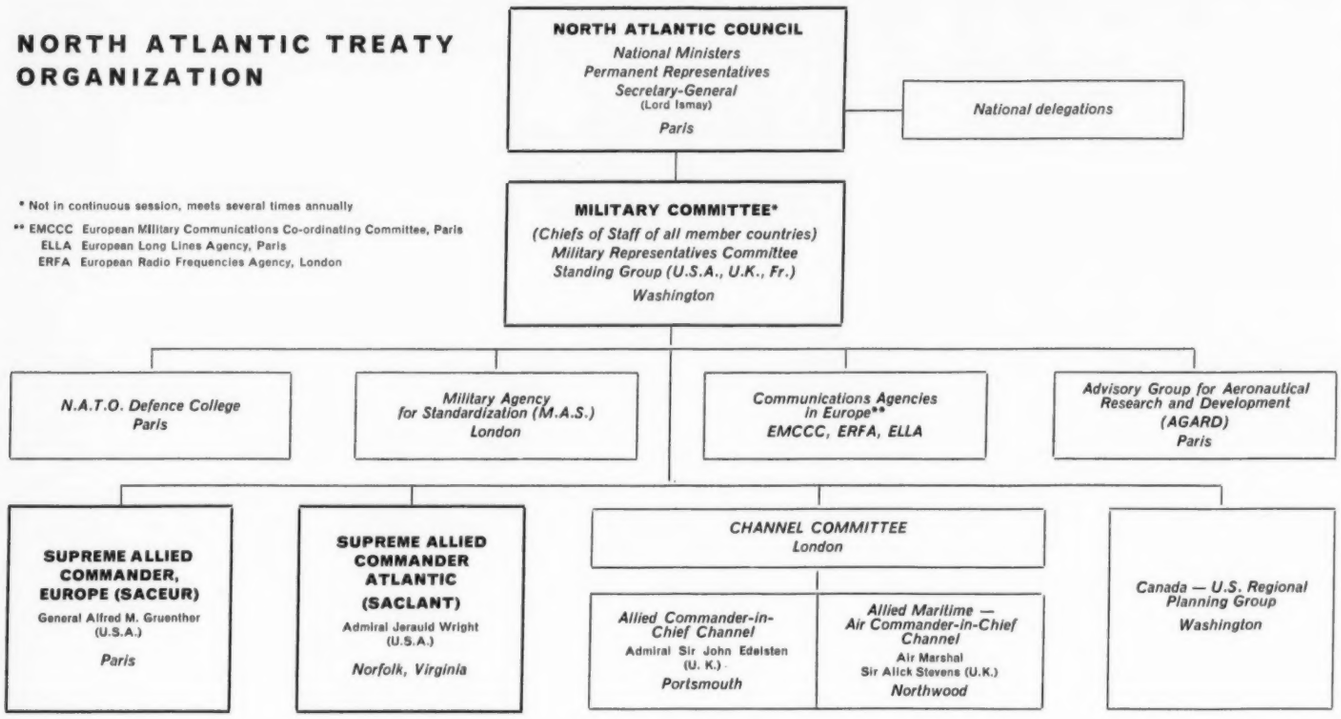
To understand these agreements fully it must be remembered that American aid to Europe is not a purely post-war development, but has been going on since the beginning of Lease-Lend in 1941. The supply of war material and the wartime military alliance was followed by an American contribution to the economic recovery of the Old World, at first granted in certain individual cases and later culminating in the Marshall Plan covering the whole of Western Europe. Incidentally, the Marshall Plan was not originally designed to be exclusive. In his speech to Harvard University on June 5th, 1947, General George C. Marshall, then United States Secretary of State, offered "*all countries West of Asia*"—*i. e, including Soviet Russia*—American aid in the "common struggle against hunger, poverty, despair and chaos". . . However, things were to turn out differently. Russia cold-shouldered the offer, and with the coming of the "cold war", aid to Western Europe once more took on a semi-economic, semi-military aspect. Today, under the North Atlantic Treaty—and because of Korea—American aid is again concentrated on the military and arms industry field.

Realistic and "optimistic" treaties

The text of the *North Atlantic Treaty* signed on April 4th, 1949, by twelve countries, most of them around the Atlantic (Belgium, Canada, Denmark, France, Iceland, Italy, Luxembourg, the Netherlands, Norway, Portugal, the United Kingdom and the United States), who were joined in February 1952 by two non-Atlantic powers, Greece and Turkey, was a model of brevity. It contained exactly fourteen articles, which made no claim to be exhaustive: a non-ag-

Dark half-tone: The 14 N.A.T.O. nations Black: Eastern bloc Shaded: Territories in which the Western Powers maintain bases. Light half-tone: Neutrals. The cities marked are the headquarters of the following N.A.T.O. organs: Washington: Standing Group (U.S.A., U.K., Fr.). London: Military Agency for Standardization. Paris + Fontainebleau: North Atlantic Council. Supreme Headquarters Allied Powers Europe. Headquarters, Allied Forces Central Europe (CINCCENT). Oslo: Headquarters, Allied Forces Northern Europe (CINCNORTH). Naples: Headquarters, Allied Forces Southern Europe (CINCSOUTH). Malta: Headquarters, Allied Forces Mediteranean (CINCAFMED).

[1] "Unity of Purpose urged for Security of North Atlantic Area". Report of General Dwight D. Eisenhower, Supreme Allied Commander Europe, to members of the Congress, February 1st, 1951. – Published by the United States Department of State.



gression pact between the countries concerned, with settlement of international disputes under the Charter of the United Nations; a very generally worded agreement on economic co-operation; a promise to assist any Party suffering armed attack (with express instructions to consult the United Nations Security Council first); the creation of a council to put the treaty into effect and to "set up such subsidiary bodies as may be necessary"; provision for review of the treaty after ten years, if required, and for denunciation after twenty years . . . That was all.

Not an elaborate "masterpiece" with dozens of committees, commissions, secretariats and section heads . . . but a typical Anglo-Saxon document, almost an improvization, in which only the immediately essential points are defined, and all details are left to the future. The architects of the North Atlantic Treaty claimed for themselves no faculties of clairvoyance. They avoided stereotyped regulations and did not impose any unacceptable restrictions on the sovereignty of the participating countries.

The North Atlantic Treaty, based on voluntary co-operation and designed to allow for growth, was the prototype of a realistic agreement.

Unfortunately the same cannot be said of all the agreements concluded since then. For example, the text of the European Defence Community pact, signed at Paris on May 27 th, 1952, comes out badly by comparison. The difference is all the more striking in that E.D.C. was designed so to speak as a subsidiary to N.A.T.O. The aim of the six signatories (Belgium, France, Italy, Luxembourg, the Netherlands and West Germany) was to enable German forces to participate in the defence of Europe. West Germany, barred from direct membership in N.A.T.O., was to be incorporated in this way in the American-European system of alliances.

Unlike the 14 articles of the North Atlantic Treaty, E.D.C.'s 132 articles touch very closely the sovereignty of the signatories. The Powers were to have no national forces (apart from certain overseas units), and merely to provide contingents for a common European Army. They might produce only such weapons as were required under a joint armament programme and approved by the commissariat. The Community's organs were to have practically the same competencies as Ministries.

Whether the E.D.C. Treaty, whose ratification has been a matter of dispute for the past two years, will ever come into force is still not clear. But that the text of the agreement was scarcely calculated to speed up its ratification should not have been difficult to foresee.

Living organization chart: Group picture showing *senior commands of N.A.T.O.* and the 14 N.A.T.O. nations (Iceland with Denmark). Names of leading N.A.T.O. generals are given in the tables to this article. Here the names of the *Standing Group* (first row, left-hand group), which comprises one member each from the United States, the United Kingdom and France and meets in Washington: (left to right) General J. L. Collins (U.S.A.), General Sir John F. Whiteley (U.K.), Lieutenant General J. E. Valluy (Fr.), the actual members of the Standing Group; second row: Vice-Admiral R. M. Dick (U.K.), Liaison Officer to the Standing Group, and Air Marshal L. Darvall (U.K.), Commandant of the N.A.T.O. Defence College.—The inscriptions on the boards in the second row mean: AFNE = Allied Forces Northern Europe; AFCE = Allied Forces Central Europe; AFSE = Allied Forces Southern Europe; AFMED = Allied Forces Mediterranean.

An alliance gets under way

"Foreign troops present a particular problem," said the Florentine statesman Machiavelli in his treatise on government written five centuries ago.[2] "If they are bad, one is lost; if they are good, one falls inevitably under their rod."

When the North Atlantic Treaty Organization began to take shape, when S.H.A.P.E. was set up in Paris and U.S.Air Force units arrived at their European bases, there was no lack of fearful spirits whose objections recalled Machiavelli's saying . . . "Wait and see," they warned, "before we know where we are Europe will be an American colony."

Now, even the most stubborn European will have to admit that so far the Americans have not shown much sign of any such desire. The United States came into World War I but withdrew lock, stock and barrel at the end of it. Their strength decided the outcome of World War II, but they were only too happy to go back home afterwards. And today the United States Congress watches jealously that only the indispensable minimum of American troops remains on European soil. Without insulting the "Old Continent," it may be said that Europe does not appear to be a very attractive capital investment as a "colony".

[2] "Il Principe", Chapter 13.

Three generations of Saceur:
(top) *General Dwight D. Eisenhower*, first Supreme Commander, handed over his command to *General Matthew B. Ridgway* at the end of May 1952.
(bottom) Since July 11th, 1953 *General Alfred M. Gruenther* (centre) has held the command. Left, Field Marshal Lord Montgomery, Deputy Supreme Commander; right, Prince Jean of Luxembourg, on a visit to S.H.A.P.E on March 30th, 1954.

How much has been achieved so far? How far has the North Atlantic Treaty Organization advanced? The best way of judging this is probably to examine what was the initial situation in 1951. In the First Annual Report on N.A.T.O.[3], which General Eisenhower presented to the Standing Group, North Atlantic Treaty Organization, in Washington on April 2nd, 1952, he describes the hopeless situation he found when he first took office. American, British, French, Belgian, Dutch and Norwegian Occupation forces were spread haphazard over the three Occupation Zones of Germany, without any contact among them. Combined exercises were unthinkable. The report continues:

"Their deployment had no relationship to what would be suitable in resisting attack. Airfields were crowded up in the forward areas, in some cases east of the ground troops that must cover them. Supply lines for British and American forces, almost parallel to the front, ran to the North German ports of Hamburg and Bremerhaven, instead of rearward through France and the Low Countries. We knew that before any division would be engaged more than

[3] Paris, 1952; pp. 37, etc.

SHAPE AND ITS REGIONAL COMMANDS

SUPREME HEADQUARTERS ALLIED POWERS EUROPE
PARIS

Supreme Allied Commander Europe: General Alfred M. Gruenther (U.S.A.)
Deputy Supreme Allied Commander Europe: Field Marshal Lord Montgomery (U.K.)
Air Deputy to Supreme Commander: General Lauris Norstad (U.S.A.)
Naval Deputy to Supreme Commander: Admiral André Lemonnier (Fr.)
Chief of Staff: Lieutenant General C. van R. Schuyler (U.S.A.)

C-IN-C ALLIED FORCES NORTHERN EUROPE
Gen. Mansergh (U.K.)
Oslo
CINCNORTH

- *Allied Land Forces Norway* — Maj. Gen. Holterman (Norw.) — Oslo
- *Allied Land Forces Denmark* — Lieut. Gen. Möller (Den.) — Copenhagen
- *Allied Air Forces Northern Europe* — Maj. Gen. Carter (U.S.A.) — Sandvika
- *Allied Naval Forces Northern Europe* — Vice-Admiral Evans-Lombe (U.K.) — Kolsaas

C-IN-C ALLIED FORCES CENTRAL EUROPE
Marshal Juin (Fr.)
Fontainebleau
CINCCENT

- *Allied Land Forces Central Europe* — General Carpentier (Fr.) — Fontainebleau
- *Allied Air Forces Central Europe* — Air Chief Marshal Sir Basil Embry (U.K.) — Fontainebleau
- *Allied Naval Forces Central Europe* — Vice-Admiral Jaujard (Fr.) — Fontainebleau

C-IN-C ALLIED FORCES SOUTHERN EUROPE
Admiral Fechteler (U.S.A.)
Naples
CINCSOUTH

- *Allied Land Forces Southern Europe* — Lieut. Gen. Frattini (It.) — Verona
- *Allied Air Forces Southern Europe* — Lieut. Gen. Craigie (U.S.A.) — Naples
- *Allied Naval Forces Southern Europe* — Vice-Admiral Combs (U.S.A.) — Naples
- *Allied Land Forces Southeast-Europe* — Lieut. Gen. Kendall (U.S.A.) — Izmir

C-IN-C ALLIED FORCES MEDITERRANEAN
Admiral Lord Mountbatten (U.K.)
Malta
CINCAFMED

- *Commander Gibraltar* — Rear Admiral Currey (U.K.) — Gibraltar
- *Commander Western Mediterranean* — Vice-Admiral Sala (Fr.) — Algiers
- *Commander Central Mediterranean* — Vice-Admiral Girosi (U.S.A.) — Naples
- *Commander Eastern Mediterranean* — Admiral Lappas (Greece) — Athens
- *Commander Southeast Mediterranean** — Admiral Mountbatten (U.K.) — Malta
- *Commander Northeast Mediterranean* — Admiral Altincan (Turkey) — Ankara

* Represented by Vice-Admiral Davis (U.K.)

forty-eight hours, it would require supply shipments of upwards to five hundred tons a day. For air units, the supply load was comparably heavy: the jet airplane burns more than a ton of fuel per hour. Obviously, a tremendous amount of depot and airfield construction would be required before our forces in this vital area were astride adequate communication routes."

In a word, at the beginning of 1951 Europe had not the slightest chance of putting up any effective resistance to an aggressor. Three years—in which supreme command in Europe has passed from General Eisenhower to General Matthew B. Ridgway (June 1952 to July 1953) and then to General Alfred M. Gruenther (since July 11th, 1953) —have sufficed for the creation of a more or less homogeneous fighting force, which, though still behind its final target in numbers and equipment, is yet an instrument on which N.A.T.O.'s Military Committee can count and which it can expand. Whereas the day the Atlantic Pact was signed there were only ten divisions and roughly 100 first-line aircraft in the whole of Western Europe, N.A.T.O. today has 40 fully-equipped operational divisions and 20 more which are not yet up to strength. By the end of 1954 there will be more than 5,000 modern aircraft available. In the event of war these would be joined by the national air forces of the United States (U.S.A.F.'s Strategic Air Command) and the United Kingdom (R.A.F. Bomber Command), which do not come under the Paris headquarters.

Admittedly, N.A.T.O.'s striking power appears modest compared with the military potential of Soviet Russia and the other Eastern Powers: the Red Army has 175 active divisions, including 65 armoured and mechanized divisions, and the satellites have 80 divisions at war strength—altogether more than 6,000,000 men; there are 20,000 aircraft in the Red Air Fleet, the majority of them jet-powered; and 300 submarines, half of them of long or medium range.

General Lauris Norstad (front left) was appointed Air Deputy to the Supreme Commander in July 1953. He was replaced as *Commander Allied Air Forces Central Europe* by *Air Chief Marshal Sir Basil Embry* (front, right). Second row: Air Commodore Wartena (Netherlands), Air Commodore Dickens (R.A.F.); third row: General D. D. Hale (U.S.A.), Colonel Bezu (Fr.).

Addressing a press conference at his Paris headquarters on May 24th, 1954, Field-Marshal Lord Montgomery, Deputy Supreme Allied Commander, Europe, said that complete reorganization of the reserve armies of all the N.A.T.O. nations was needed. The Eastern *bloc,* whose mobilization system is constantly exercised, could put 400 divisions into the field 30 days after mobilization. He warned that the introduction of atomic and thermo-nuclear weapons must basically affect both organization and tactics. Any attempt to meet these weapons with the outdated tactics of World War II would be doomed to failure from the outset. It was erroneous to maintain that atomic weapons would not be used or that they would not affect the methods of land warfare. Nevertheless, he felt that the West's present strength would suffice to meet a surprise attack by the 22-division spearhead stationed in East Germany.

Financially speaking, the N.A.T.O. nations have made heavy sacrifices for their defence organization. A glance at the defence budgets of the nations concerned shows that the burden has more than trebled since 1949:

Defence Budgets of NATO Nations

in million dollars

Country	1949	1950	1951	1952	1953[1]
Belgium	153	165	268	401	450
Canada	338	450	1,159	1,917	2,171
Denmark	52	52	69	98	156
France	1,370	1,599	2,517	3,706[2]	4,086[2]
Greece	109	131	222	164	221
Italy	482	565	731	842	835
Luxembourg	2	3	5	9	11
Netherlands	179	237	279	330	417
Norway	52	50	80	116	159
Portugal	50	53	54	58	76
Turkey	258	248	273	307	386
United Kingdom	2,181	2,377	3,218	4,377	4,957
United States	13,300	14,300	33,216	47,671	51,860
Europe (total)	4,888	5,480	7,716	10,408	11,754
N.A.T.O. (total)	18,469	20,163	41,970	59,904	65,674

[1] Estimated.

[2] Including U.S. Arms aid of $60,000,000 in 1952, $177,000,000 in 1953.

These burdens are even heavier since the economic reconstruction of Europe is by no means complete. Hence it is understandable that all the Allied nations should wish to reduce their commitments where possible. On the other hand, the North Atlantic Council decided during 1953 that a certain slowing down, a stretchout of the programme was permissible. A number of European countries had stated at the Eleventh Session of the Council in April 1953 that they could only fulfil their part of the programme if the United States continued to provide substantial economic assistance. However, the United States made it clear through their President and their Secretary of State, that even they could not bear such a burden for an unlimited period. Moreover, there had been a considerable change since N.A.T.O. had been created. The initiative was passing more and more to the West. Whereas it was at one time thought that the West's full defensive strength must be built up by a given date in the relatively near future, the conviction today is that the immediate urgency is past.

The nations finally agreed (Paris North Atlantic Council meeting in December 1953) on a "long haul" concept, a "New Look" armament policy which also seemed to suit Staff planning.

However that may be, it is clear that N.A.T.O. members' defence expenditure has been invested in an undertaking that has developed out of a vision into a reality. In April 1950 General Pierre Billotte, former head of the French delegation to the United Nations Security Council, described the state of Europe as follows: "Such of Europe as is still free and which we must defend is nothing, on the scale of a modern world conflict, but a pitiful little peninsula, on which weigh the whole Eurasian land mass and the whole military power of the U.S.S.R." Today this Europe is doing a practical job of work and has taken its fate in its own hands.

An alliance gets under way: episode from N.A.T.O. "Exercise Mainbrace," task of which was to repel a theoretical invasion of Northern Europe (Autumn 1952).

N.A.T.O. Air Forces' Modern Equipment

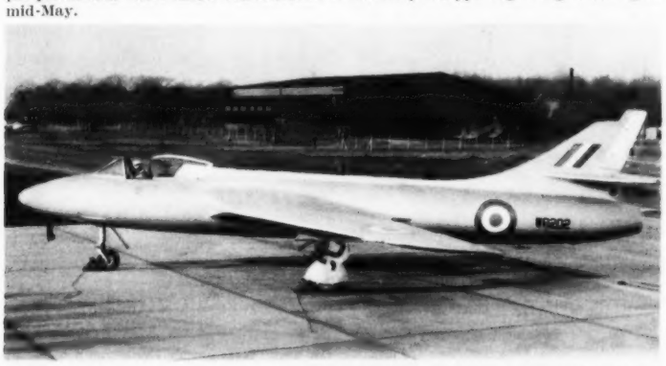
The pictures on these pages show the newer types of aircraft which equip the North Atlantic Treaty airforces today or will become available to them in the near future. A number of well-known older types still in squadron service, such as the de Havilland *Vampire* and *Venom*, Gloster *Meteor* fighter, Dassault *Ouragan*, SNCASE *Mistral*, etc., have been omitted. Naval aircraft are also not included; they are listed elsewhere in the issue. Finally, no mention is made of a whole series of recent American fighters—Lockheed F-94C *Starfire*, Northrop F-89D *Scorpion*, North American F-100 *Super Sabre*, McDonnell F-101, Convair F-102, Republic F-103 and F-105 and Lockheed F-104—as in all probability these aircraft will be used initially only for the protection of the United States and be sent to non-American bases only in exceptional cases.—Details of the fighters, fighter-bombers, all-weather fighters and bombers were published in *Interavia* No. 3, 1954 (pp. 147–149), 9, 1953 (p. 503), 8, 1953 (p. 396) and 3, 1952 (pp. 132–137).

Dassault Mystère IVB (F): Single-seat day fighter, in production. Second prototype recently began flight testing. Night fighter version *Mystère IVN* (two-seater).

SNCA du Sud-Est SE. 5000 Baroudeur (F): Interceptor and ground attack aircraft; pre-production series under construction. A second prototype began flight testing in mid-May.

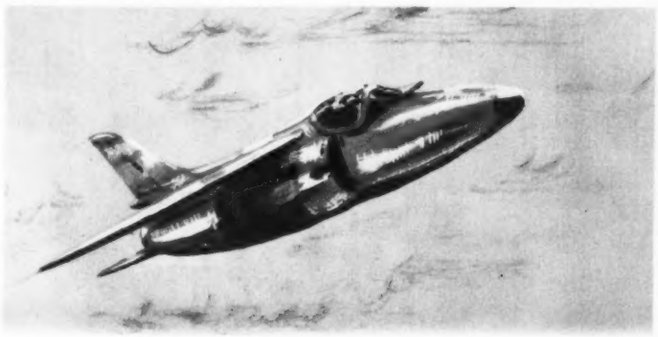
Vickers-Supermarine Swift 4 (U.K.): Single-seat day fighter, the Mark 1 and Mark 2 versions of which have recently gone into squadron service. Marks 2 and 3 are in production, and will be followed by Mark 4.

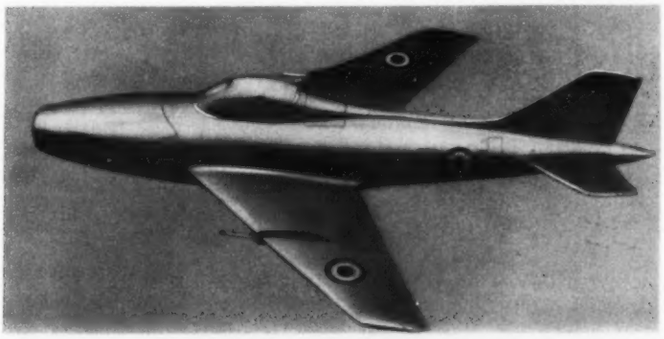
Folland Fo. 141 Gnat (U.K.): Stripped-down interceptor. Two prototypes under construction (first flights end of summer 1954, and 1955 for second prototype). A ground attack version is projected.



Hawker Hunter F.2 (U.K.): Single-seat day fighter, the F.1 version of which has been built in some numbers (70 to 100 aircraft). Equipment of the first *Hunter* squadron began in May 1954.

Aerfer-Ambrosini-Stefanutti Sagittario II (Italy): Light interceptor, of which several prototypes are reportedly under development. A ground attack version is also planned.



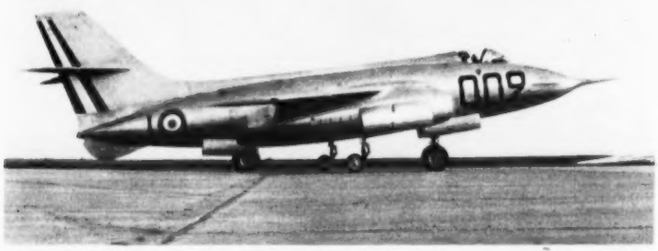


Republic F-84F Thunderstreak (U.S.A.): Single-seat day fighter and fighter-bomber; swept-wing development of the *Thunderjet*, which has been supplied to a number of N.A.T.O. countries; built in large numbers.

North American F-86D Sabre (U.S.A.): All-weather single-seat fighter and fighter-bomber. Other recent versions of the *Sabre* are the F-86H and F-86K (licence production by Fiat).

Gloster Javelin FAW. 1 (U.K.): Two-seat all-weather fighter, to be built in considerable numbers. The fourth prototype (picture) recently began flight testing. Operational by 1954-55.

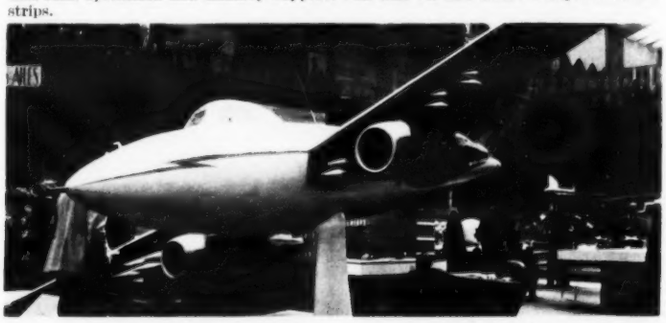
Avro-Canada CF-100 Canuck 3 (CAN): Heavy all-weather fighter which can also be used for ground support. Production of *Canuck 3* phased out; *Canuck 4* now in production.



NCA du Sud-Ouest SO. 4050 Vautour (F): Single or two-seat aircraft in quantity production; designed as ground attack aircraft, all-weather fighter or bomber. Picture shows single-seat ground attack version.

Polez 75 (F): Prototype of a two-seat ground attack aircraft specially designed for anti-tank operations and infantry support. Can take off and land on improvised airstrips.

Gloster P.V. Meteor (U.K.): Ground attack version of the *Meteor 8* with 24 rocket projectiles; only one prototype has been built.



Fouga CM. 82-R Lutin (F): Prototype of a racing single-seater, which could also serve as the flying model for a light ground attack aircraft (cannon and rockets).

Douglas A3D-1 (U.S.A.): Naval version of the B-66 three-seat tactical bomber (or RB-66 reconnaissance bomber) in production for the U.S.Air Force. The B-66 has a radar bomb sight.

English Electric Canberra (U.K.): Light bomber in quantity production: also built in U.S.A. (Martin B-57A and B-57B) and Australia. Picture shows *Canberra B-6*. Ground attack version under development.

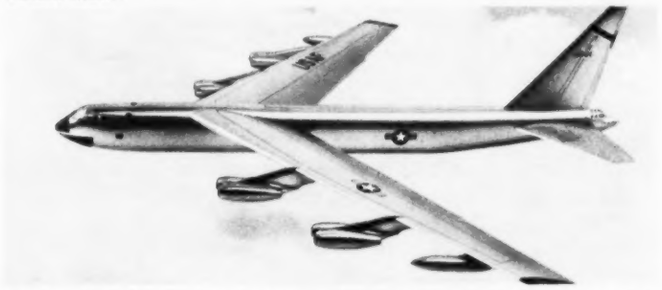
Avro Vulcan B.1 (U.K.): Medium bomber, delta-wing, being built in quantity under the British Super-Priority programme.

Handley Page Victor B.1 (U.K.): Medium bomber with crescent wing, also in production under the Super-Priority programme.

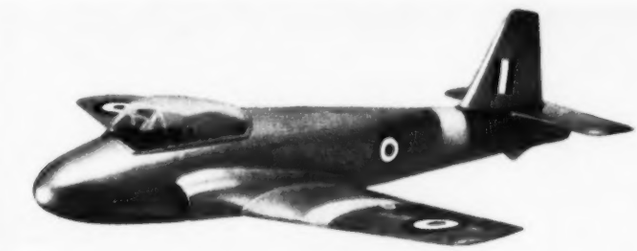
Vickers-Armstrongs Valiant B.2 (U.K.): Super-Priority medium bomber. B.1 version in production. Picture shows B.2 version.

Convair B-36 D (U.S.A.): Heavy long-range bomber, production of which is to be phased out at the end of 1954. Latest version, designated B-36J, equipped to carry parasite fighter.

Boeing B-47 Stratojet (U.S.A.): Medium bomber produced in large numbers. Latest version, B-47E, with remote-controlled tail armament and radar sights.



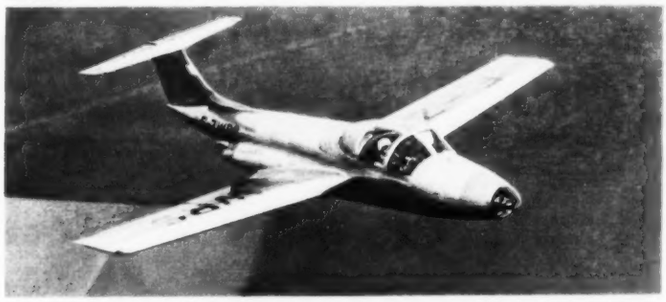
Boeing B-52 Stratofortress (U.S.A.): Heavy long-range bomber; B-52A version now in production. First B-52A recently completed.



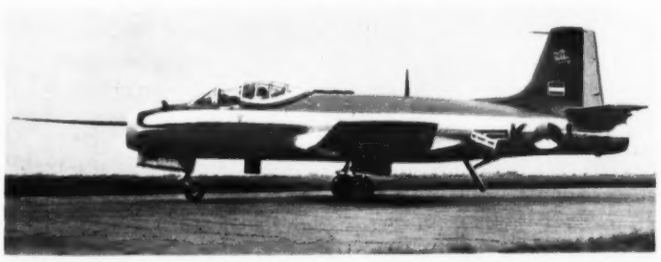
Percival P.84 Jet Provost (U.K.): Two-seat elementary trainer, whose prototype is to begin flight testing this summer. A small pre-production series has been ordered by the R.A.F.

Avro 707 C (U.K.): Two-seat trainer version of the Avro 707 experimental aircraft. The same firm is also working on a delta-wing light fighter-bomber and ground attack aircraft.

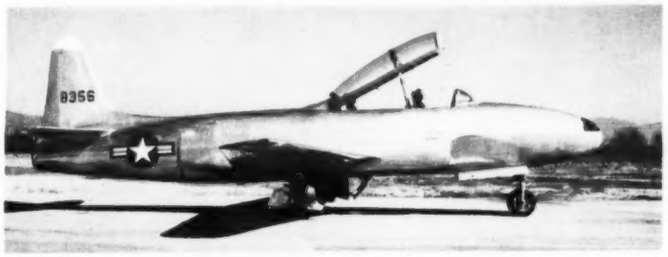
Fouga CM. 170-R Magister (F): Two-seat trainer, first pre-production model recently completed. Pre-production batch of 10 is to be followed by quantity production.



Morane-Saulnier MS 755 Fleuret (F): Two-seat trainer not at present to go into production. However, grant of production licences to other countries is under discussion.

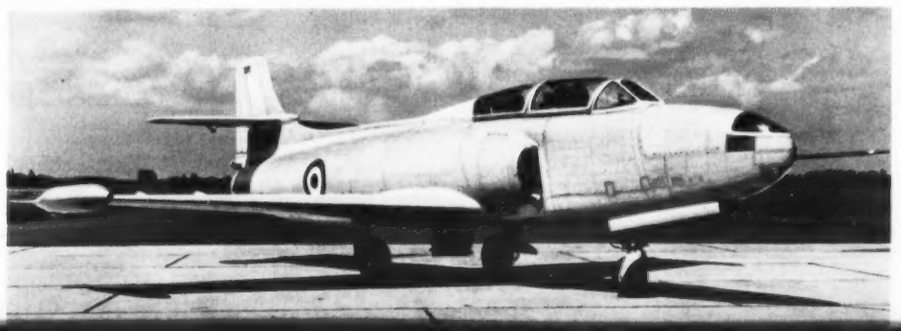


Fokker S. 14 Mach Trainer (Netherlands): Two-seat trainer for advanced training. Originally powered by Rolls-Royce *Derwent*; later version (picture) has the bigger R.-R. *Nene*.



Lockheed T-33A (U.S.A.): Built in considerable numbers; two-seat trainer version of the Lockheed F-80 *Shooting Star* single-seat fighter. Produced under licence by Canadair Ltd. In use in nine Western countries.

Fiat G. 82 (Italy): Advanced trainer developed from the G.80 two-seater; G.82 prototype recently began flight testing at Turin-Caselle airfield.



1945 - 1954

HOW THE NEXT WAR WILL DIFFER FROM THE LAST

1 Since 1945 world policy has been founded first on the American A-bomb monopoly (until 1949) and subsequently on America's lead in atomic weapons. Tomorrow the damage resulting from a general war in which nuclear and thermo-nuclear weapons are used will determine international relations.

2 To a certain extent the localized conflicts of recent years result from the existence of the atomic threat. In assembling the conditions for such a conflict, whether in Korea or in Indo-China, the Communist world gambled on the assumption that they would not invite atomic retaliation, although they were depriving the Western World of some of its resources, dislocating its economy, and shaking its unity.

3 A new climate has thus been created in which provocation must be much graver before a nation goes to war. In the atomic age the Ems Dispatch would not unleash a war between the two most powerful countries, as it did between Germany and France in 1870. "Acceptable" hostilities will remain relatively limited in scope and not menace directly or immediately the actual existence of the countries having a stock of atomic weapons.

4 There are now two types of conflict. One is called conventional because atomic weapons are not used. The other would lead to general involvement and mass destruction. War to extermination is now possible.

5 Parallel to these two forms of conflict there will be two types of armed forces, each with different principles of employment, tactics, equipment and armament. The only thing they have in common is a form of guerilla force. Thanks to the lightness of its units, the nature of its armament, its optimum use of terrain features, the moral strength it presupposes, it could be effective in both a localized war of the Indo-China variety (up to May 1954 at any rate) and in an atomic war (reduced vulnerability of units, high mobility, simplicity of supply system). But it is obvious that the guerilla type organization, however necessary it may appear, will not be sufficient.

6 The magnitude of destruction wrought by an atomic attack in a minimum of time gives an aggressor the maximum advantage. He can finish the conflict by unilateral action, since his victim will almost immediately be either robbed of his means of retaliation or too weakened to use them successfully. Yesterday it was still possible to "plan" a major war by calculating the rate of attrition of the enemy's forces. In an atomic struggle the opposing sides do not wear each other down gradually, they decimate or exhaust each other virtually with a single blow.

7 Today the initial objective in an atomic war would be the destruction of the enemy's atomic retaliation force. To wipe out his major population centres or even his seat of government would have no effect if he still retained the means of launching his aircraft missiles against the aggressor. It follows that today the vital targets are stocks of A-bombs and the means of delivering them rather than yesterday's strategic targets, such as industrial potential, cities, ground and naval forces.

8 It can be argued that a general atomic conflict could not be unleashed unless the aggressor was sure that

a) he could either destroy in the first attack practically all the atomic weapons which the enemy could launch against him, or

b) he could intercept practically all the enemy's atomic missiles before they reached their targets on his territory.

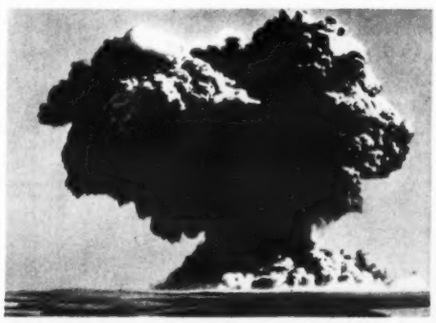
9 Yesterday, Pearl Harbour was not a decisive operation. Though the surprise attack with conventional equipment succeeded in hampering America's naval operations in the Pacific for a time, it did not conquer the United States or discourage their retaliation—quite the contrary. Today an atomic assault on the enemy's military machine could annihilate it at a single blow. Hence, atomic bombs would be the armament for possible future "Pearl Harbours" —this time decisive.

10 Yesterday war and peace were two clearly separate states. Today the speed with which the major effects of atomic war can be achieved makes it impossible to maintain any great difference between peacetime and wartime armed forces.

11 Yesterday the bombing threat to a major town was serious only if there was a substantial discrepancy between attacking and defending forces, as in the case of Warsaw and Rotter-

Monte Bello Explosion, 1952

"Unconventional" A-bomb: This series of five pictures illustrates the explosion of Britain's first atomic device in the Monte Bello Islands, off the North West Coast of Australia in the autumn of 1952. Unlike U.S.-made "A" and "H" bombs, the typical mushroom cloud did not form fully but was quickly spread out by the wind. — **1** The fireball of the Monte Bello explosion. **2** The mushroom cloud begins to form. **3** The cloud formation is now two miles high and about a mile across. **4** About 25 minutes after the explosion; the cloud begins to disperse northwards but to sea. **5** Thirty minutes after the explosion; the cloud is now fifty miles in length.



dam. Today, the threat is much graver. The experts on the U.S. Lincoln project cannot guarantee the destruction of more than 30% of the aircraft attacking targets several thousand miles from their bases, so that it is difficult to see how sufficient A or H bomb carriers could be intercepted to discourage such an attack or provide adequate defence against it. If only a single aircraft gets through the defences, the target can be destroyed.

12 For the first time in history, a relatively small group of combatants has held the power of vast armies in balance. This group comprises the crews of the U.S. Strategic Air Command, who have balanced, unaided, the mighty Russian military machine through the combination of an elusive "carrier" and the explosive of a power from 20 kilotons to 10 megatons.

13 Yesterday bombing produced effects only over a long period. During five and a half years the Allied Air Forces dropped nearly 1,500,000 tons of bombs on Germany, but this air offensive had an only patchy effect on German war production. Industry simply adapted itself to the constant raids by decentralizing and going underground. Today the time needed to cause severe damage is very much shorter, especially as repair services will be saturated by the intensity and extent of the damage.

14 Yesterday it took up to a thousand bombers carrying TNT bombs to produce a decisive effect on a single major target. Today one aircraft reaching its target is enough to cause critical destruction. Yesterday it was the number of aircraft available that fixed the limits of the strategic offensive. Today, it is the number of atomic bombs in existence, since the means of delivering them are abundantly available.

15 During the last war, mastery of the air was gained only after a long struggle. After several years of battle conducted from bases outside continental Europe, the Anglo-American Air Forces cleared the skies and opened the way for invasion and ground conquests. Today air supremacy is won in peacetime. The stakes in a general conflict are so high that atomic aggression will surely only be resorted to if the aggressor is certain of its victorious outcome.

16 Yesterday, all air defences had two objects: to disorganize enemy raids and inflict maximum losses on the attacker. If they knocked down a mere 10 % of the bombers they were considered successful, since this was a high price for the enemy to pay for indecisive damage inflicted on the ground. Today, it would be necessary to intercept 100 % of the A-bomb carriers before they reach their targets if crippling damage is to be avoided. This is clearly impossible.

17 Yesterday the means of delivering conventional bombs, i. e., the aircraft and it's crew, were much more valuable than the bombs they carried. The relatively restricted power of destruction of conventional explosives made repeated return missions by the same crews and aircraft necessary. The power of atomic bombs has altered the old relationship between carrier and explosive. Modern strategic bombers have sufficient range to reach any target. They will not necessarily be required to return to base, since the first attack by a relatively small number of machines would be sufficient to bring the enemy to terms.

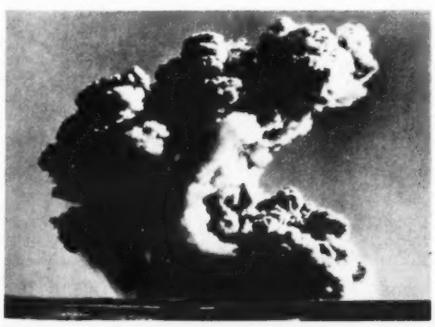
18 Yesterday a surprise attack on aircraft on the ground by means of conventional bombs destroyed a maximum of 15 to 20 % of the aircraft. Today a surprise attack with A-bombs can destroy 80 to 90 % of the enemy air forces, unless they are dispersed and protected in peacetime as they would be in war.

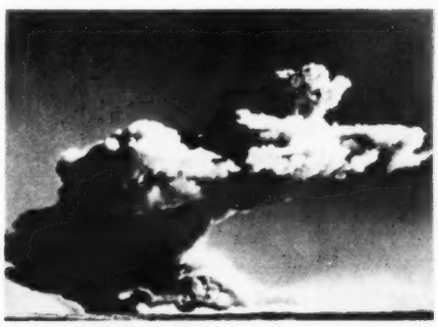
19 Yesterday the civil defences were able to prevent complete dislocation of everyday life by conventional air bombing. Today their task would be virtually impossible. Val Petersen, U.S. Civil Defense Administrator, stated some months ago that if 67 major centres in Federal territory were attacked by atomic bombs, there would be nine million deaths and twenty-two million seriously injured. How could the survivors cope with the immediate results of such a holocaust?

20 Civil defence experts are aware that the H-bomb has completely upset past conditions. Industry must be decentralized, alternative sources of production created, new road systems built to by-pass built-up areas and important targets, stocks of civil defence equipment increased, stores of medical supplies established, prefabricated or tented towns provided to receive evacuees, orderly evacuation planned to avoid panic. Town-planners and architects must be prepared for towns and suburbs to spread out considerably.This means new communications networks, more means of transport, a new organization of life and work.

21 Yesterday shipping sought protection by sailing in closed convoys. Today it must disperse, thus falling an easier prey to enemy submarines. Hence it is necessary to build up a fleet of long-range transport aircraft to carry troops and supplies and thus escape the enemy's atomic and submarine threat. This in turn presupposes that departure and arrival bases must themselves be less vulnerable to atomic attack.

22 Yesterday military potential was measured by a nation's moral strength, the industrial power it could mobilize, the quality of it's arms, the military forces immediately available and mobilizable later. The distribution of strength between the three main services, army, navy and air force, depended on the strategy adopted, the latter being determined by the nature of the enemy threat, geography, population, climate, etc. Today the relative strength of two possible adversaries is determined by the size of their A-bomb stocks, means of delivery, range, precision, invulnerability of these means, ability to withstand the initial atomic blow, and recuperative powers after such an attack.





N.A.T.O.

EFFECTS OF Nuclear Weapons

The ranges of destruction shown in the five diagrams below are defined as follows:

Blast:

1 Total destruction (steel-frame or concrete buildings, stone or concrete walls).

2 Total destruction of ordinary buildings (16-inch brick walls).

3 Total destruction of light buildings, collapse of roofs, cracks in heavy buildings, destruction of rolling stock and road vehicles.

These three degrees of destruction correspond to the following pressures:

1 25 to 29 lbs./sq.in. **2** 5 lbs./sq.in. **3** 3 lbs./sq.in.

Heat:

(clear weather)

1 Universal outbreak of fire.

2 Isolated outbreaks, third degree burns.

3 Moderate burns.

Radiation:

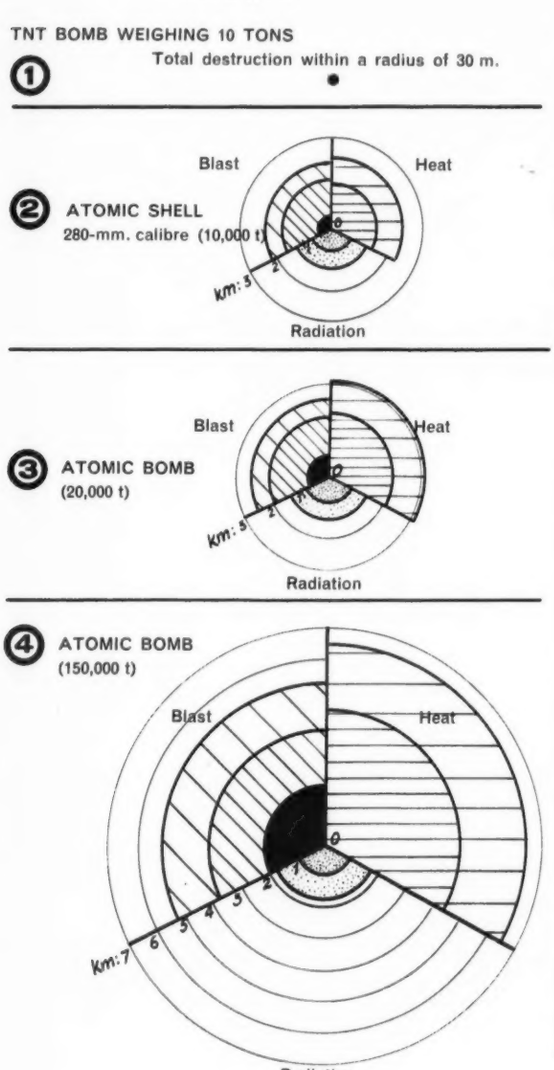
1 Fatal dose (400 roentgens) for unprotected personnel, from initial gamma ray emissions.

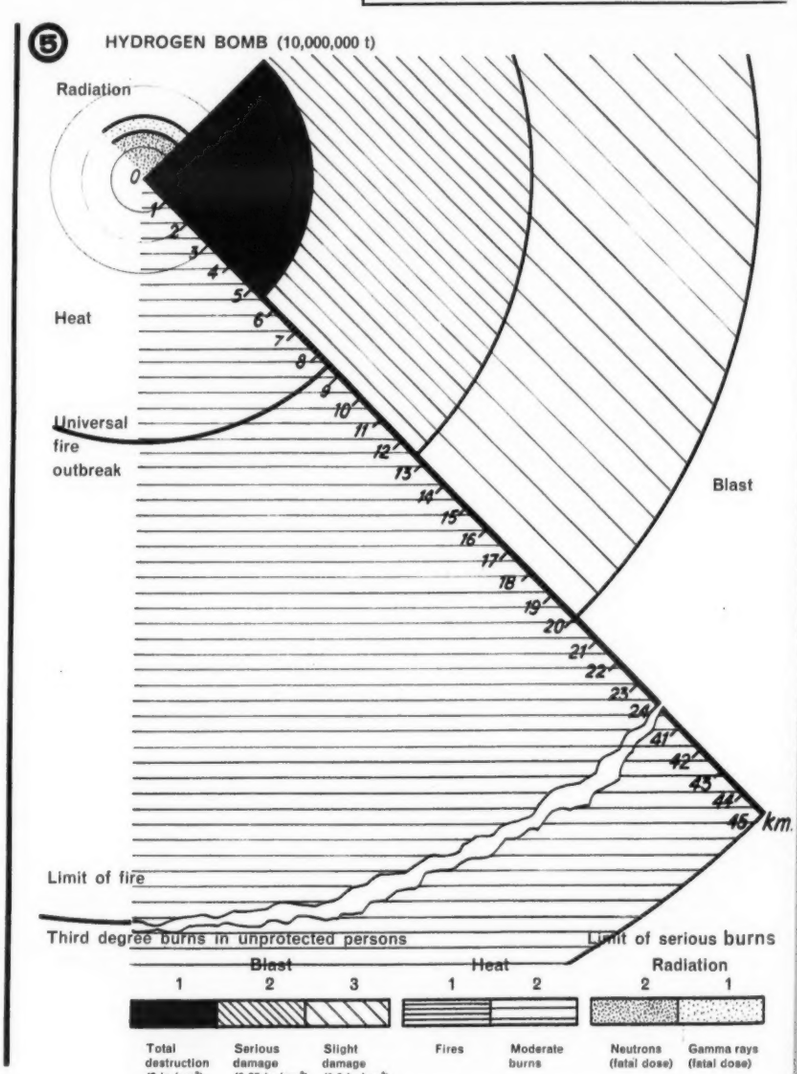
2 Fatal dose for unprotected personnel, from neutrons liberated by the explosion.

Explosive power in t TNT	Intensity grade 1–3	Limits of grades: Blast m	Heat * m	Radiation m
10 t	1	30	—	—
	2	110	—	—
	3	160	—	—
10,000 t	1	400	—	1,220
	2	1,525	1,500	650
	3	2,150	2,300	—
20,000 t	1	600	—	1,300
	2	1,950	2,000	800
	3	2,500	3,100	—
150,000 t	1	2,000	—	1,700
	2	3,750	4,300	980
	3	5,200	6,500	—
10 Mt**	1	5,500	8,500	2,000
	2	12,500	45,000	1,500
	3	20,000	140,000	—

* Clear sky ** 1 Mt (Megatonne) = 1,000,000 t

1 TNT BOMB WEIGHING 10 TONS
Total destruction within a radius of 30 m.





Effects of blast:

In even atmospheric conditions the effects of blast are roughly proportional to the cube root of the power of the explosion. Theoretically the effects of a 20-kiloton bomb (equivalent to 20,000 tons of T.N.T.) must be multiplied by 8 (roughly the cube root of 500) in order to get the effect of the 10-megaton H-bomb. This rough law indicates total destruction within a radius of 6,000 yards, serious destruction within 13,500 yards and serious to moderate effects up to 22,000 yards from ground zero.

Total destruction means collapse of buildings with steel or concrete frames and concrete (or concrete and stone) walls. Serious destruction is the demolition of ordinary buildings (stone, thick brick walls), of masts, lamp-posts, sign-posts, road vehicles, railway trucks, aircraft. Moderate damage includes roofs blown off, doors and windows destroyed, walls shaken, unprotected or lightly protected persons killed. In practice, a 10-megaton H-bomb would incapacitate unprotected personnel in flat country, without natural or artificial screen, up to a distance of about 18½ miles from the explosion.

Effects of heat

The amount of heat required to cause third degree burns in man is roughly 58 to 65 calories per sq. in. In theory, in clear weather and where no natural or artificial screen protects him, the infantryman can receive third degree burns up to about 25 miles away from the explosion of a 10-megaton H-bomb.

In practice the state of the atmosphere would considerably reduce this distance. In very cloudy weather, for example, it might be cut down to half.

To start fire in a wooden structure, for example, a heat of 162 calories per sq. in. is needed. With an A-bomb this heat can be obtained within a radius of 13,000 yards of the explosion. In theory the same amount of heat could be recorded 27,000 yards from the explosion of a 10-megaton H-bomb.

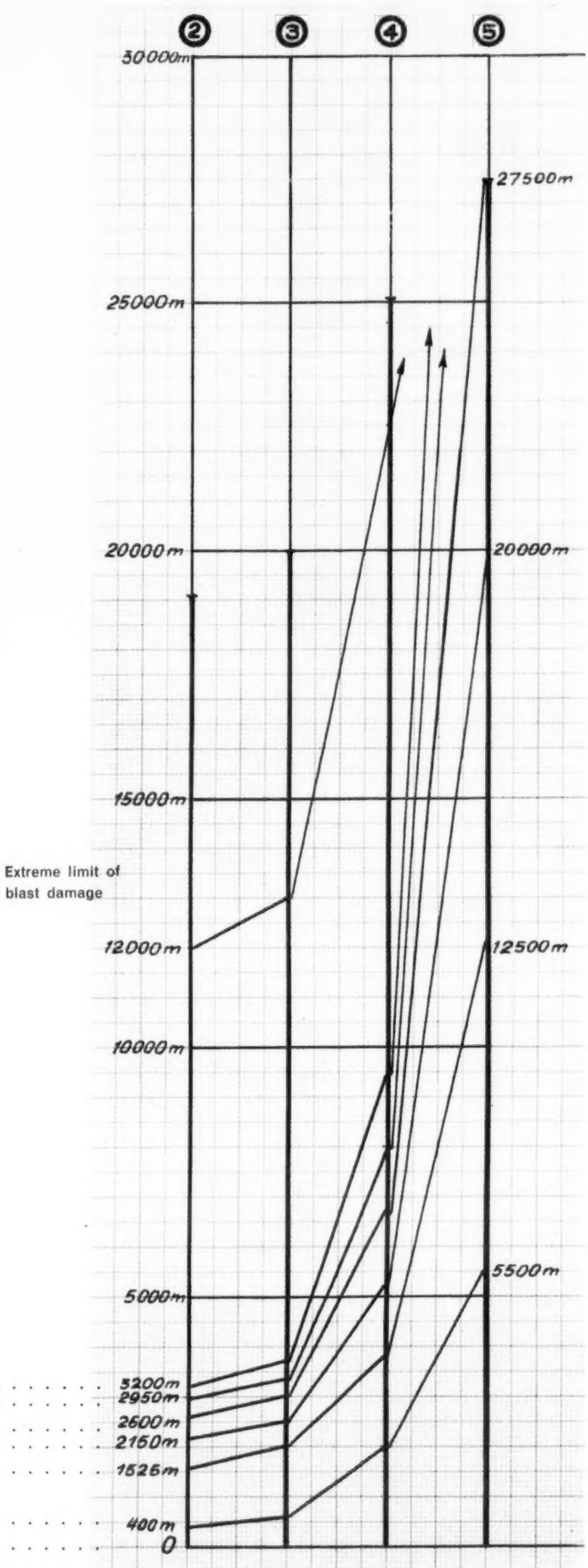
Effects of radiation

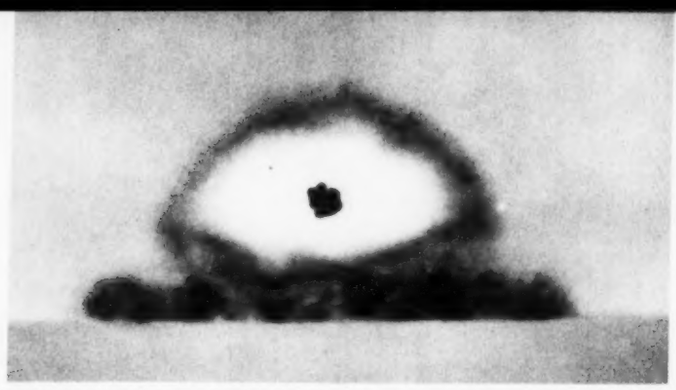
Table and diagrams show that the intensity of electromagnetic gamma radiation and neutron radiation increases only slightly with the multiplication of the explosive power. The radiation effects of the H-bomb are not very different from those of the largest A-bomb (150,000 tons TNT). The reason is that the H-bomb's radio-active products come almost entirely from the A-bomb which is used as detonator.

Comparison of zone limits (metres) for blast damage caused by atomic weapons

(2=atomic shell with 10,000 tons explosive power; 3=20,000 tons; 4=150,000 tons; 5=10,000,000 tons)

	2	3	4	5
Windows broken	5200m			
Roofs blown off	2950m			
Buildings partially destroyed	2600m			
Aircraft and vehicles damaged	2150m			
Brick buildings (16-inch walls) destroyed	1525m			
Steel and concrete buildings destroyed	400m			
Ground zero (centre of explosion)	0			





July 16th, 1945: America exploded her first atomic bomb (Uranium 235) in the "Test Trinity" at Alamogordo, New Mexico. A similar bomb was dropped on Hiroshima, Japan, on August 6th of the same year.

August 9th, 1945: The A-bomb (Plutonium 239) dropped on Nagasaki, Japan, caused the final collapse of Japanese resistance. Photo was taken by Hiromichi Matsuda, an industrial worker, on the outskirts of Nagasaki twenty minutes after the explosion.

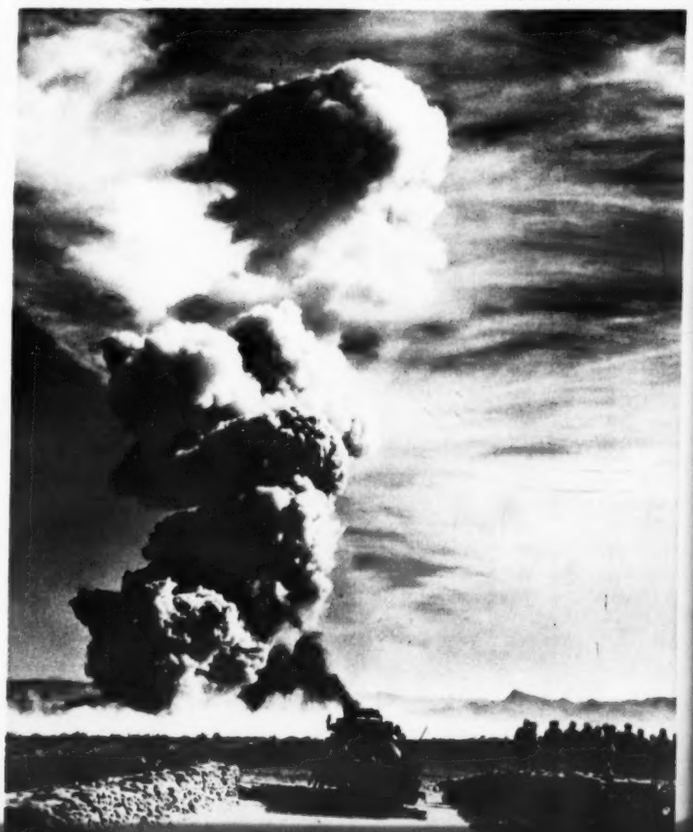
July 25th, 1946: "Test Baker", an underwater explosion (Plutonium 239), took place at Bikini following "Test Able" on July 1st, which was a mid-air detonation (Plutonium 239).

November 1st, 1952: "Operation Ivy", in the Marshall Islands, represented the explosion of the first Americain hydrogen device. It was not a bomb, because with indispensable equipment it weighed 65 tons. It probably consisted of a Plutonium 239 detonator and a main charge of astronomically expensive liquefied hydrogen isotopes (deuterium and tritium) cooled to -250 deg.C. Since that date America has adopted the Russian H-bomb formula based on cheaper and easily obtained lithium hydride. Devices built to this formula (probably including air-transportable bombs) were subsequently exploded in the Marshall Islands on March 1st, March 26th and April 6th, 1954.

Development of tactical A-bombs (Plutonium 239) was initiated following the outbreak of war in Korea. They were extensively tested in 1952 at the Atomic Energy Commission's proving grounds in Nevada. Picture shows U.S.Marines taking part in a tactical test.

America's Atomic Milestones

The U.S.Army developed a 280-mm gun firing atomic shells. Picture shows the mushroom cloud rising from the first such shell fired in Nevada on May 25th, 1953.



For you and your friends!

It pays to subscribe to "Interavia Review"

For rates and agents see over

Please send "Interavia Review" for one year in English — French — Spanish — German* to the address indicated below.

INTERAVIA

Review of World Aviation

Payment of the subscription fee of ..... is made herewith by ..... **

Please begin delivery with the issue for ..... 19 .....

(Block Letters)
Name : .....

Address : ..... Town : ..... Country : .....

Profession : ..... Employer : .....

For gift subscriptions :
The subscription for the above address has been ordered by : .....
(Name and Address)

.....

Date : ..... Signature of Subscriber : .....

* Please check language desired.
**Please insert cheque, postal order, money order, cash.

INTERAVIA REVIEW

Please fill in the Address

Rates and Agents :

Austria	S. 180	Morawa & Co., Wollzeile 11, Vienna 1.
Belgium	Fr. b. 360	Office de Publicité, 16 rue Marcq, Brussels.
Brazil	Cruz. 230	R. F. Besnard, 9a Av. Almirante Barroso, S.417-149, Rio de Janeiro. — R. F. Besnard, 131, rua Marconi, 5° And., Sao Paulo.
Canada	$7	Wm. Dawson Subscription Service Ltd., 587, Mount Pleasant Road, Toronto 12, Ontario.
Denmark	Kr. 48	Dansk Centralagentur, Stormgade 20, Copenhagen.
France	Fr. fr. 2,400	Interavia, 144 Avenue des Champs-Elysées, Paris 8°.
Germany	DM 27.50	Interavia Verlags-G.m.b.H., Flughafen Düsseldorf-Lohausen, and W.E. Saarbach G.m.b.H., Gereonstrasse 25-29, Cologne.
Great Britain	~~£2.8.0d~~ £1.15.0d	Interavia (U.K.) Ltd., Standbrook House, 2-5, Old Bond Street, London, W.1.
Holland	Hfl. 28.00	Henk A. Jansen, Olympiaplein 84, Amsterdam Z.
Italy	Lit. 4060	Interavia, 30, Via San Marino, Rome 7.23.
South Africa	£2.6.0d.	Interavia, P.O. Box 6073, Johannesburg.
Spain	Ptas 275	Saenz de Pazos, Donoso Cortés 85, Madrid.
Sweden	Kr. 35	Interavia, Postbox 29, Linköping.
Switzerland	Fr. 28	Interavia, Corraterie 6, Geneva.
Uruguay	Pesos 23	R. F. Besnard, Edificio Artigas, Rincon 487, Montevideo.
U.S.A.	$7	Interavia, 185, Madison Avenue, New York 16, N.Y.

Don't Pin the Air Force to the Ground

Dispersed, protected or buried, it can survive an atomic attack

BY INTERAVIA'S STUDY GROUP

The "New Look" arms programme, giving first priority to the air arm, has been widely discussed by staffs, strategists and the supporters of other arms. At the Pentagon the struggle has been fierce. To increase the fire power of the ground units and give the United States' present thirteen divisions the same punch as 39 divisions of ten years ago did not not seem to be enough unless the number of such divisions was also increased. The Navy was concerned at an evolution that seemed to condemn it to disappear from the seas. A land division can disperse its men and equipment so as not to form a worthwhile target for atomic attack, but an aircraft carrier cannot split up into small pieces, at any rate not until the present experiments in vertical take-off and landing produce combat aircraft with high operational performance. The Air Force's ambitions were also opposed by the other two services with the objection that though the aircraft was still the best vehicle for delivering a decisive atomic offensive, it was badly equipped to meet the destructive effects of an initial enemy attack. It might perhaps escape interception in flight, but its vulnerability on the ground was great ...

As the military instrument the West was preparing was to be for defence only, or perhaps for retaliation, it was foolish to base its defensive potential on an arm which could so easily be annihilated on its bases even before it could execute a single mission in reply to an enemy initiative. It is sure that, with the exception of the aircraft carrier, nothing is more vulnerable to atomic attack than an air base, with its installations concentrated in a small space to simplify peacetime operations, and its aircraft perhaps dispersed sufficiently to provide protection from the gunfire or the 2,000-lb. bombs of ten years ago. Installations above ground level and particularly flying equipment are scarcely designed to take the sledgehammer blows of atomic weapons. All that was found of the "guinea pig" aircraft left on the deck of the U.S.S. *Independence,* 500 yards from the point of explosion of the first A-bomb at Bikini, was twisted metal and gutted fuselages. Very little equipment can resist the blast and the heat wave which accompany the explosion. The destructive effects, based on the information published in the Atomic Energy Commission's book "The Effects of Atomic Weapons", are summarized in the following table:

	A-devices (20 kt) yds.	*A-devices* (150 kt) yds.	*H-devices* (10 mt) yds.
Equipment rendered unserviceable within a radius of	2,000	4,000	16,600
Limited damage within a radius of	4,000	7,600	24,200
Destruction of buildings within a radius of	2,600	5,100	19,700

Though carrier-borne air units would have difficulty, at any rate today, in surviving the surface destruction of atomic projectiles, land-based air forces can take advantage of *dispersion, mobility* and *partial protection,* and perhaps tomorrow they will manage to put their bases of departure *underground.*

By dispersing, they can reduce the target for a single atomic missile to scattered installations and a relatively small number of aircraft, thus rendering attack unrewarding. The degree of

HOW THE AIR FORCE CAN MEET THE ATOMIC THREAT

	Measures	Principles	Effect on aircraft and ground organization
1. TRANSITION PHASE	Spreading out of parking areas around existing runways Increase in number of runways Modification of existing installations to provide some protection	Dispersion on scale of airfield Dispersion on scale of theatre Local protection against effects of heat and blast	Use of present equipment Same ground organization as in pre-atomic age —
2. NEW PHASE — A **New aircraft** **New bases** **New organization**	Increase in number of *take-off strips* of small dimensions Mobility of light units stationed near these *strips* Local protection by provision of screens and shelters	Dispersion on scale of theatre Protection by mobility and rapidity of change of station Semi-buried system	New aircraft adapted to new type of ground organization New light ground organization. Return to pre-1939 fields Command and maintenance adapted to this dispersion
3. NEW PHASE — B **New aircraft** **New ground organization** **New organization of units**	Increase in take-off *points* Mobility of light units stationed around these *points* Protection by means of screens and shelters	Dispersion on scale of theatre Mobility Semi-buried system	New aircraft capable of using take-off points Creation of a ground organization consisting of points Maintenance adapted to this dispersion
4. TOTAL PROTECTION — A **Suitable aircraft** **New ground organization** **Same organization**	Burial of air bases	Concentration of installations underground Fixed system of bases Total protection against air bursts, partial protection against surface explosion	Suitable aircraft Creation of entirely new ground organization —
5. TOTAL PROTECTION — B **New aircraft** **New ground organization** **Same organization**	Buried take-off "plateaux" for aircraft taking off and landing vertically	Fixed system of bases Total protection against air bursts, partial protection against surface explosion	Creation of entirely new ground organization
6. TOTAL PROTECTION — C **New aircraft** **New ground organization** **New organization of units**	Dispersion and burial of take-off bases for aircraft taking off and landing vertically	Dispersion and burial Fixed system of bases Complete protection against air bursts, partial against surface or underground explosions	New vertical take-off aircraft Creation of new ground organization New means of command and maintenance

N.A.T.O.

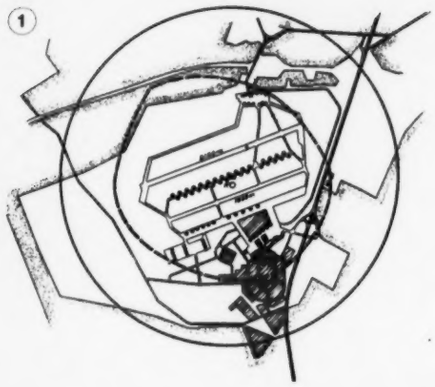


Fig. 1: Rhein-Main Airport, Frankfurt, is used here as a guinea pig. It is assumed that 86 aircraft are at the airport, 32 of them on the parking area between the two runways. A 20-kiloton A-bomb exploding 2,000 ft. above ground zero would totally destroy all buildings and aircraft on the airport. The unbroken circle marks the limit of total destruction. The area of "moderate" damage cannot be shown on the scale of this diagram, but would extend to a radius of about 4,000 yards. If the A-bomb exploded on the ground it would make a crater more than 500 ft. in diameter, and the "spout" of earth and wreckage thrown up into the air would add to the destruction of such equipment as escaped the direct effects (blast and heat). – The 20-kiloton bomb is more than sufficient for this task. Even an error of over 1,000 yards in the point of detonation (for an overhead explosion) is permissible. Provided the bomb bursts within the area marked by the dotted line the airport will be put out of service for several days, and its flying and technical equipment destroyed.

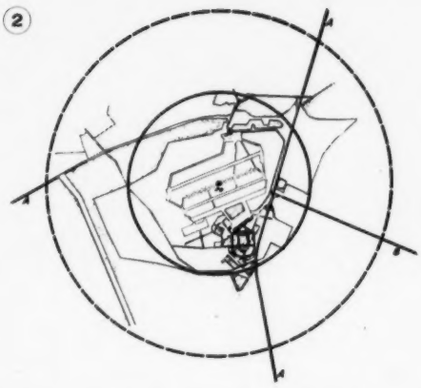


Fig. 2: This diagram, on half the scale of the previous one, shows the area of total destruction of flying equipment (unbroken line) and the area of partial destruction (dotted line), assuming the explosion of a 20-kiloton bomb above ground zero. Partial destruction will be very unevenly distributed because of the natural screens offered by the terrain. However the trees round the airport will probably not provide effective cover, and fire will break out within a radius of about 4,000 yards of the explosion. *A = Autobahn, B = Road.*

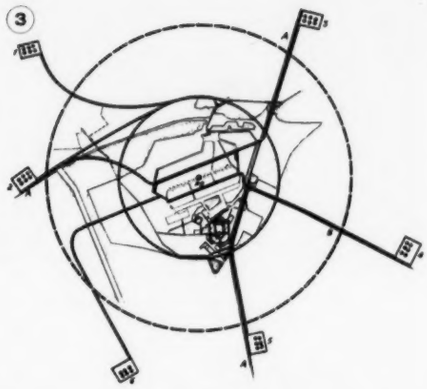
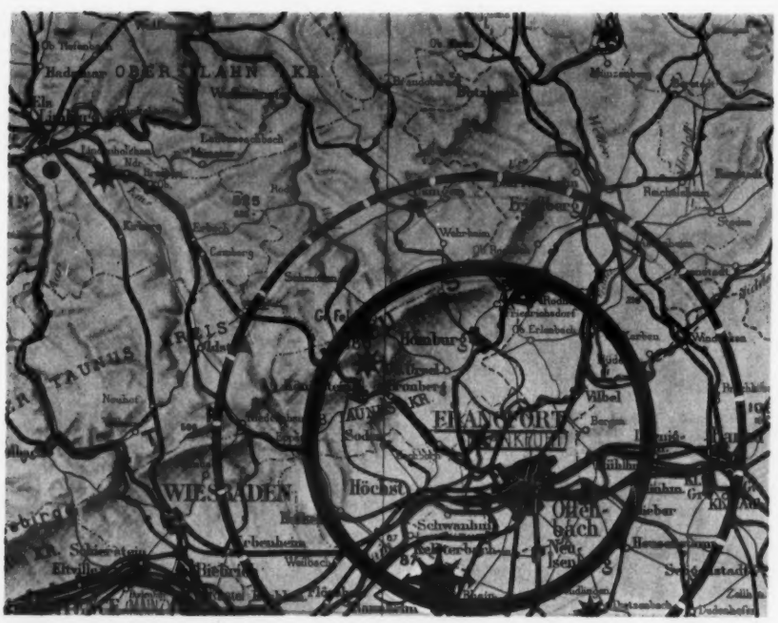


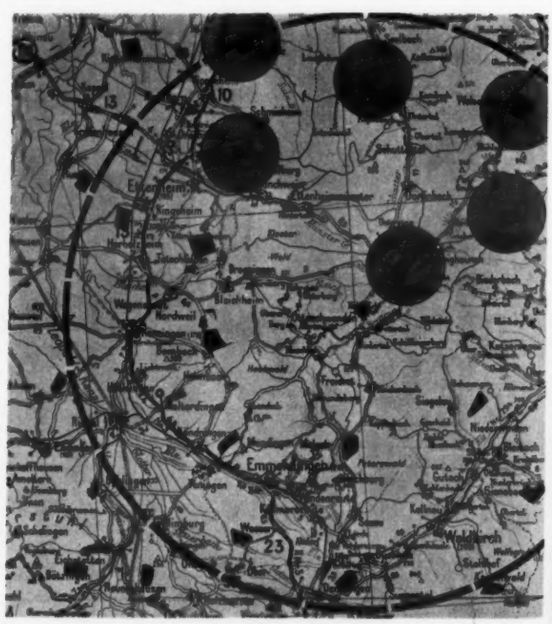
Fig. 3: Frankfurt Airport on the same scale as the preceding diagram, showing the areas of total (unbroken line) and partial destruction (dotted line) and a suggestion for reducing the vulnerability of the flying equipment. The suggested solution makes use of existing runways, taxiways and roads. With limited modifications – new connecting tracks, widening of existing tracks (e. g. road widened at B) – aircraft on the ground could be dispersed, and maximum use made of the airport's present equipment. Six dispersed parking areas, each sheltering six aircraft, have been marked. Except in the north-west area of the airport (parking areas 1 and 2), one 20-kiloton bomb would not destroy more than six aircraft, and would therefore probably not be used, since the cost of the bomb would be out of all proportion to the effects obtained. On the other hand, it would be difficult to get these 36 combat aircraft into the air. Aircraft will have to cover distances of well over 3,000 yards to reach the take-off runway and cannot therefore get into operation rapidly. Moreover such dispersion in peacetime will necessitate additional personnel and equipment and hence increase expenditure of all kinds. Another point is that the new dispersed base for the atomic age can take less than half of the original 86 aircraft, which means that double the number of bases will be required to handle the same number of aircraft. – A smaller degree of dispersion would suffice if artificial protection could be provided (embankments, screens, blast walls). Combined with dispersion, this artificial protection can reduce its disadvantages. – These are measures which can enable existing air bases to be used in the atomic age. They form a transition between the aerial deployment of the past and that of tomorrow, since they offer a degree of safety while enabling use to be made of existing aircraft and of air bases constructed without allowance for the destructive potential of atomic weapons.

Fig. 4: Passing to a much bigger scale and considering not only the airport at Frankfurt but the whole city and the other airfields around it (five airfields, including a master base), there are sufficient targets within an area of less than 770 square miles to justify an attack by a 5 to 10-megaton H-bomb. The areas of serious and moderate damage are marked in the map. If ground zero were about 3 miles north-west of the centre of Frankfurt, both the city and four out of the five airfields around it would be destroyed. Obviously terrain shields could reduce the intensity of damage, particularly in the north-west on the airfields near Königstein. The dispersion suggested above would be of little value here. Very much greater dispersion distances would be needed. But above all it is essential to relate the dispersion of installations to the vulnerability of a country's critical points to atomic attack. It is not very likely that an H-bomb would be allocated to destroy some forty aircraft. But it might well be used against a city as important as Frankfurt, especially if four air bases can be put out of action and their equipment annihilated at the same time.

Fig. 5: Large air bases, more often than not grouped around a city which itself forms a worthwhile target, can be replaced by a series of widely dispersed take-off strips. Diagram shows an area of 3,080 sq. miles in which twenty strips have been arranged, each capable of being used by a light unit of some ten aircraft. It would take at least twenty A-bombs of less than 10 kilotons each, if aim were always accurate, or of 10 to 20 kilotons if allowance must be made for probable inaccuracy, to destroy the 200 aircraft thus dispersed. By ordinary standards this would seem to be an extravagant use of nuclear explosives. – On the other hand, if the enemy considered that these 200 aircraft form a target worth an H-bomb (of 5 to 10 megatons), the whole area would be affected and, in theory, six strips out of the twenty would escape destruction of their installations and equipment. However, the take-off strips could be arranged to take full advantage of terrain cover, which would greatly reduce the effects of blast and heat. Here it is obvious that special aircraft are required, capable of using small take-off strips, of "living" in small isolated units, of being supplied by lighter and more mobile means than in the past. – The combination of dispersion and great mobility would make atomic attack on air bases less certain of success, since aircraft could be moved before the enemy could act on the information supplied by his reconnaissance aircraft.

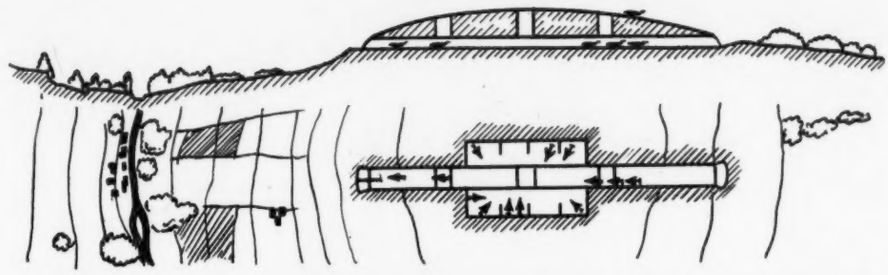


4

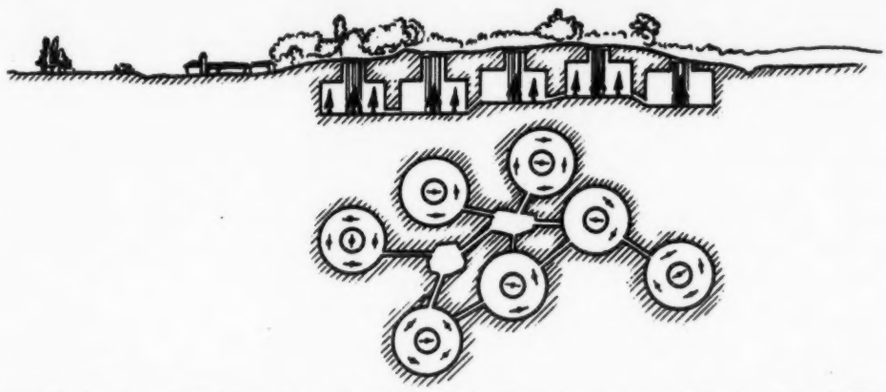


5

dispersion needed depends naturally on the number of atomic projectiles which one of the belligerents can use for the destruction of the other's air force, the range of power of these projectiles, the nature of the terrain and the geographical situation of the airfields in danger (distance from sources of enemy air power, proximity to some other major target which would enable an atomic raid to reach two or more categories of target with the same blow). This will increase the number of atomic projectiles which the enemy will need to neutralize an opposing air force and hence may exhaust his offensive potential. Of course, if he uses H-bombs the whole situation changes, and the degree of dispersion must be greater. It is in fact the H-bomb threat that may force the air force to go underground in addition to dispersing.



The underground air base may then appear as the effective answer, though complex and costly, to enemy atomic raids. Fig. shows an underground take-off runway. Landing is made against the slope, and the aircraft taken down to the underground hangars by elevators similar to those used in an aircraft carrier. This "Maginot Line" of underground air bases would tie down the ground organization, but the aircraft specially designed to operate from such installations would have sufficient range to compensate for the static nature of such an air force. The latter would in any case be protected against any atomic attack launched without warning and could retaliate with all its strength. But new aircraft and vast construction work would be needed.



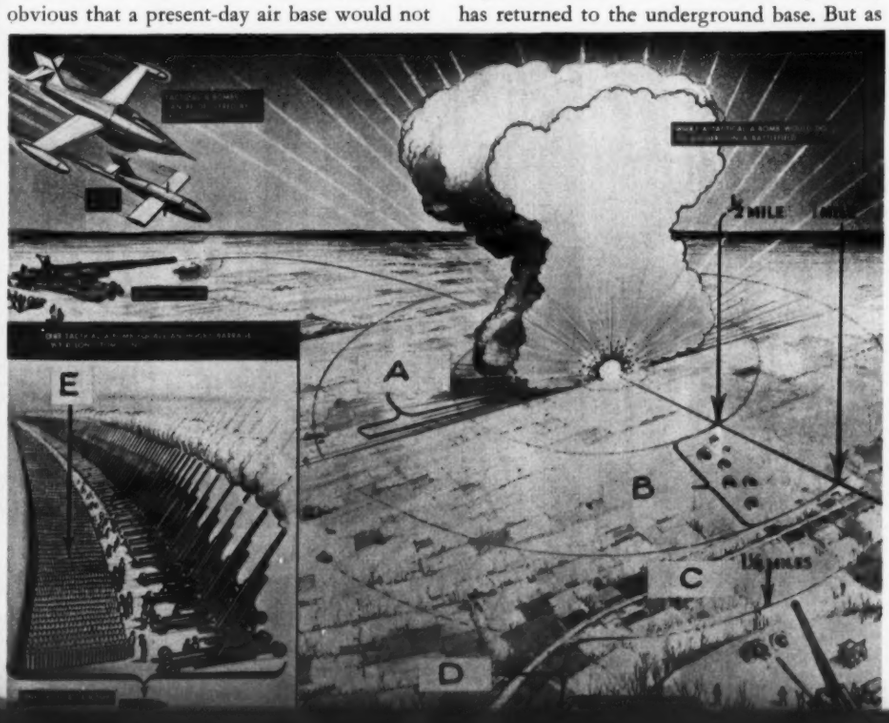
Vertical take-off aircraft could greatly simplify protection against the destructive power of the A or H-bomb. Fig. illustrates a "buried" squadron of about thirty vertical take-off fighters installed in what might be described as vast shallow wells, interconnected so as to permit of technical maintenance and administration. This solution would be better suited to a static defence force, since it is attached to the defence of critical points – rather than to a tactical force whose task is to take part in the essentially mobile land-air battle.

However, to protect itself against the effects of an A-bomb, even of 100 to 200 kilotons, the air force can combine dispersion of its fixed installations and the mobility of its flying units. Its deployment then takes on the aspect of a vast checker board on which certain of the squares are sometimes empty, sometimes partially occupied. If frequent moves are made —they are by nature rapid—the enemy's reconnaissance will have the utmost difficulty in keeping his command accurately informed. And the latter cannot risk his precious atomic weapons unless he is sure of success.

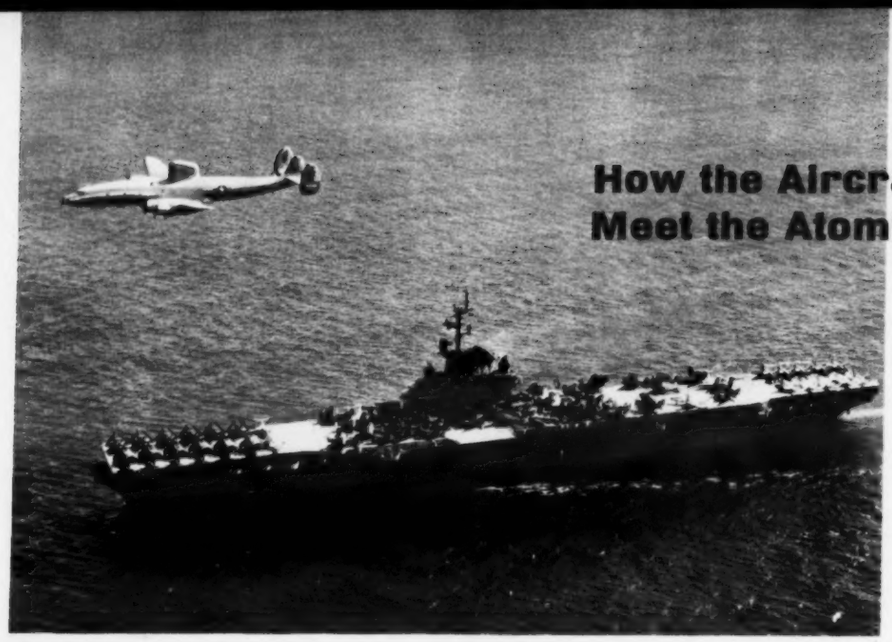
Partial protection must also be retained. It can minimize the effects of blast and heat from the atomic explosion and protect an important percentage of the equipment not in the immediate vicinity of ground zero. If the explosion takes place in the air, semi-underground parking bays, embankments, natural or artificial screens can reduce the percentage of aircraft rendered unserviceable by atomic attack. If the projectile explodes on the ground the radius of destruction is smaller, but it is obvious that a present-day air base would not be proof against it and would immediately be put out of use because of the crater and the wreckage of all kinds which would be blown into the air and then fall back on to the airfield.

If the H-bomb became current, even a combination of dispersion, mobility and partial protection would no longer suffice, at any rate to protect a major air force. Therefore planning has returned to the underground base. But as it is possible that atomic projectiles may some day penetrate to a considerable distance before exploding, it is only a combination of deep burial and wide dispersion that can provide a relatively satisfactory solution. This evolution in the protection of the air force against the effects of nuclear weapons is illustrated by the table and the maps on these pages.

A study of the effects of the atomic weapon on aerial deployment shows that entirely new concepts are needed as regards aircraft, ground equipment, organization and composition of units, maintenance and technical supplies services. The air force need not be the victim of the extraordinary power of destruction which it carried for the first time from the islet of Tinian to Hiroshima. If it submits to a technical and tactical revolution it can adapt itself and not only survive but also dominate the atomic age.



The drawing shows how atomic firepower can be used at the front lines, and how tactical A-bombs compare with conventional artillery fire. The estimated ranges of effect on soldiers in the field are indicated: A – small chance of survival for exposed troops within ¾ mile; B – possible safety for soldiers in good foxholes; C – serious burns on exposed skin up to 1 ¼ miles; D – comparative safety beyond 1 ¼ miles. The power of one tactical A-bomb equals the destructive fury of four thousand 155 mm shells (E) delivered in an hour's barrage by 100 Long Tom guns.



N.A.T.O.

How the Aircraft Carrier can Meet the Atomic Threat

BY VICE-ADMIRAL F. BARJOT

The safety of aircraft carriers will largely depend upon sufficiently early warning of impending atomic attack. Picture shows a Lockheed WV-2 "Flying Radar Station" over U.S.S. *Oriskany*.

The growing number of atomic bombs of various sizes and the introduction of the hydrogen bomb will not only modify land war fare. What will become of the war at sea when the use of atomic guided missiles, bombs and artillery shells becomes general? Will the aircraft carrier, which has succeeded in adapting itself during the past few years to supersonic jet aircraft and can now launch A bombers, survive general use of atomic weapons by an enemy? In other words, will the floating air base survive the development of nuclear weapons?

The two Bikini tests (1946)

The first warning came in 1946 from operation "Cross Roads" at Bikini. The experiments were conducted by the U.S. Navy, under Admiral William Henry Purnell Blandy. In the first test ("Able") an A-bomb of approximately the Hiroshima type was detonated at about 2,300 ft. above a fleet of 93 naval vessels (86 surface vessels and 7 submarines) anchored in the atoll, 20 of which were concentrated in one square mile. The object of test A was to measure the vulnerability of surface vessels to the blast and heat of an overhead atomic explosion.

A second test ("Baker") was made in the same atoll on July 25th, with the same concentration of shipping. This time the explosion took place 15ft. below the surface. In Test Able, the B-29 "Dave's Dream" aimed at the centre of the moorings occupied by the battleship *Nevada*. The light aircraft carrier *Independence*, which was 500 yards from ground zero (point vertically below the explosion) was seriously damaged and caught fire. The flight deck was buckled by the blast, especially at the stern which was the part most exposed. But the carrier remained afloat.

In Test Baker on July 25th, the aircraft carrier *Saratoga* fared badly. Hit below the water line by the under-water explosion, it took on such a heavy list that the aircraft on deck slid off into the lagoon, and finally the old *Sara* foundered.

Is the optimism of 1946 still justified?

At Bikini two unmanned aircraft carriers were victims of the A-bomb, the *Independence* on July 1st and the *Saratoga* on July 25th. But both were only a short distance from the centre of the explosion. Otherwise it was found that the damage sustained by ships 800 yards or more away was not serious.

Must we conclude that the 1946 Bikini experiments reassured rather than disturbed the U.S. Navy? It is a fact that except for minor details the characteristics of new warships were not modified to provide protection against atomic blast and heat. In particular, aircraft carriers of the *Forrestal* class are being built with an entirely flush deck, without shelter on it for operational aircraft. Was the optimism of 1946 also due to the fact that at that time the United States had a monopoly of atomic weapons?

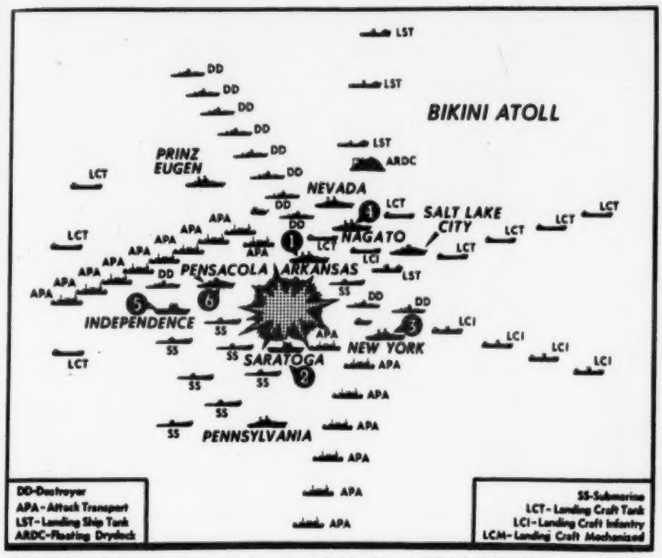
The end of the American monopoly and the creation of a Russian strategic bomber force

In fact, the A-bomb did remain entirely in American hands until 1949.

It was on September 22nd, 1949 that the Russians exploded their first atomic bomb, and similar tests were resumed in October 1951. President Truman had reacted on February 1st 1950, by giving the green light for the hydrogen bomb. Development took eighteen months, and the first practical experiment was made at Eniwetok on November 1st, 1952. The results of this experiment were kept strictly secret, at least for a year.

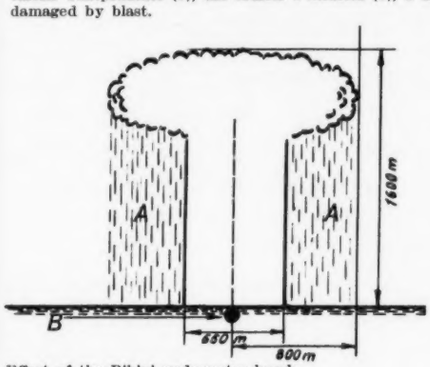
But the American H-bomb lead did not last a full year. On August 9th, 1953, Georgi Malenkov announced that Russia, too, had the hydrogen bomb. Subsequently, new American experiments were pushed ahead. These took place in March and April this year, again at Eniwetok. At the same time some of the terrifying effects of the first hydrogen device tested in November 1952 were divulged. We learned that a whole islet had disappeared . . .

At the same time the Russians began building a modern long-range strategic bomber force. Hence, the Russian A-bomb can now reach the cities of Western Europe and the United States, the ports and the waters of the North Atlantic. The danger to the navy is obvious. This brings us back to the question of "bombs versus ships".



Test Baker: Diagram shows the location of shipping at Bikini at the time of the underwater explosion. The battleship *Arkansas* (1), the carrier *Saratoga* (2), a concrete oiler and a tank landing ship were sunk; the battleships *New York* (3) and *Nagato* (4), the carrier *Independence* (5), the cruiser *Pensacola* (6), a destroyer and a transport were damaged by blast.

Operation "Crossroads, Test Baker", at Bikini, July 25th, 1946. A plutonium bomb was detonated 15 feet under water.



Effect of the Bikini underwater bomb.
A = Radio-active rain
B = Bomb detonated 15 feet under water.

Atom bombs of 1954

What is the radius of destruction of the various atomic devices as far as ships at sea are concerned?

In America there are—according to the newspapers—four types of A-bomb, all equal or superior in power to the Hiroshima bomb, and two types of H-bomb.

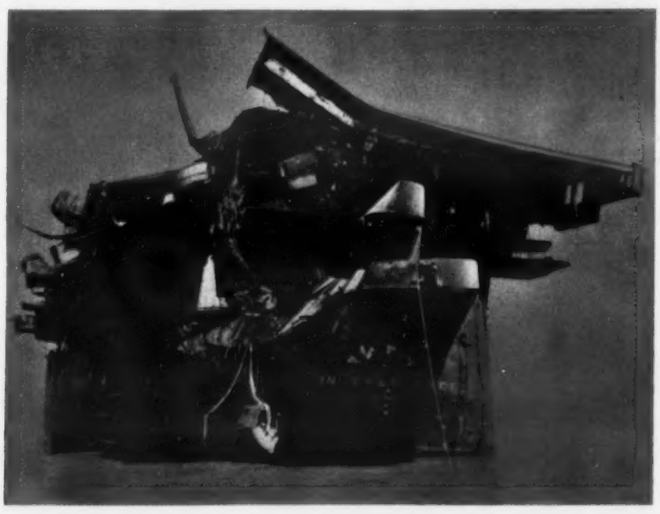
The power of the Hiroshima bomb, which serves as the criterion, was equivalent to 20 kilotons (= 20,000 tons) of TNT.

There are also "tactical" projectiles of lower power than the Hiroshima bomb. These include 280 mm-calibre atomic artillery shells weighing 600 lbs., with a power equivalent to 10 kilotons of TNT, or half that of the Hiroshima bomb, but with a range of up to 25 miles. The light A-bomb (1,300 lbs.), which can be carried by carrier-borne fighters such as the McDonnell *Banshee* and *Demon*, or fighter-bombers such as the Republic F-84F *Thunderjet*, represents 30 kilotons of conventional explosive or more than the Hiroshima bomb. Leaving aside hydrogen bombs, the A-bombs most likely to be used at sea will be equivalent to 10, 20, 30 and 50 kilotons.

Concentration and dispersion

The defence of aircraft carriers at sea is not a problem that can be solved on its own. The carrier will have to be integrated in a concentrated defensive naval force comprising several aircraft carriers (fighters and attack aircraft) surrounded by a number of purely defensive vessels (anti-aircraft artillery and surface-air

Bikini, Test Able, July 1st, 1946: Damage caused to the stern deck of the battleship *Nevada* and to the flight deck of the Light Fleet Carrier *Independence* by the mid-air plutonium-bomb explosion. The *Independence* was further damaged in Text Baker but did not sink.



rockets), not to mention anti-submarine escorts. On the other hand, the wider radius of destruction of the A-bomb necessitates a certain dispersion of the defensive vessels. Can these two requirements be reconciled?

It is agreed that a distance of 1,500 yards between ships is sufficient against 20-kiloton A-bombs (Hiroshima). For the 30-kiloton bomb a distance of 1,800 yards would probably be great enough to ensure that damage would be restricted to one vessel. Spacing would increase to 2,000 yards for 50-kiloton bombs and to 3,000 or 3,500 yards for the super A-bomb of 500 kilotons. Needless to say, such a spacing would be ample for 10-kiloton artillery projectiles.

In the majority of cases, thus, a distance of *2,000 yards* between ships would provide sufficient dispersion, while ensuring the concentration of fire needed for efficient anti-aircraft defence, since the range of present-day 127-mm and 152-mm anti-aircraft rockets is much longer than this distance.

The H-bomb is a different matter, since spacing between ships would have to be increased to 15 or even 20 miles. Local anti-aircraft defences cannot operate over such ranges. It would therefore appear to be useless, at any rate under present conditions, to seek dispersion distances of more than 3,000 yards.

Mobility

One of the essential features of the high-speed aircraft carrier is its great mobility, compared with the land air base. Moreover, the flight deck of an aircraft carrier is ten times shorter and twenty times smaller in area than an equivalent air base on land.

This small platform can manoeuvre and change direction at will, and move at 35 knots, which will considerably complicate the problem of aiming bombs or guided missiles from the necessary high altitude or distance.

Fighter defence — Early warning aircraft

To meet an atomic attack launched from a distance it is essential to get the earliest possible warning. Radar in aircraft carriers and defence vessels at present gives 20 minutes warning of aircraft flying at high altitude. This is adequate for aircraft carrying A-bombs, but not always sufficient for aircraft launching guided missiles from a distance.

To get more than 20 minutes' warning, early warning aircraft are used, of which the lighter ones can operate from the aircraft carriers themselves (e. g. the 7-ton *Skyraider*).

The radar network at sea can also be extended by heavy land-based early warning aircraft, such as the 50-ton Lockheed WV-2, a special version of the *Super Constellation*. This aircraft carries 6 tons of radar equipment and a crew of 31 working in two shifts.

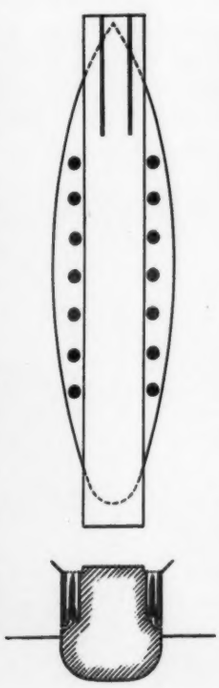
It has a panoramic radar 18 ft. in diameter in ventral and dorsal radomes and a radar 10½ ft. high to measure altitudes of enemy aircraft, from sea level to more than 65,000 ft. The WV-2 itself flies at 30,000 ft., which enables it to detect low-flying aircraft up to a distance of 400 nautical miles. The U.S.Navy is putting 90 of these aircraft into service, the first of which took part in exercise "Mariner" in September 1953. Carrier-based and land-based fighters thus have time to get into the air before the A-bombers arrive.

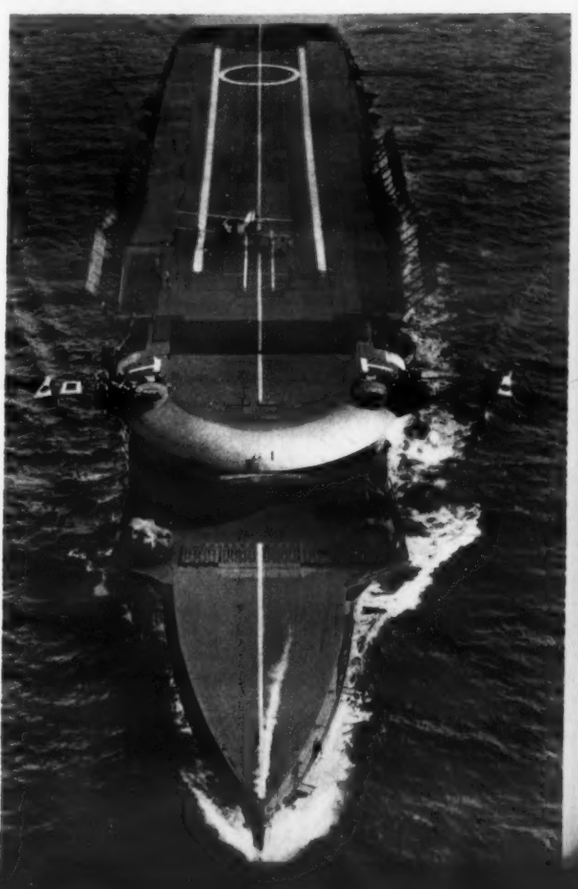
Anti-aircraft rockets

Air-to-air rockets can reach A-bombers from greater ranges than the 20 or 30-mm cannon of the newest fighters.

The *Sparrow* air-to-air guided rocket, developed by Sperry and Douglas between 1948 and 1951, is already in use by carrier-based fighters

Right: Double-decker carriers would offer protection to aircraft waiting on the lower deck to be catapulted. *Below left:* Modern jet fighters escort naval strike aircraft and defend the carrier against atomic attack. Hawker *Sea Hawks* aboard a British carrier. *Centre:* Diagram of an aircraft carrier capable of firing guided missiles. *Right:* Double-decker carriers might resemble the old British carrier *Furious* with the exception of the shape of the forward catapult deck.





A Douglas F3D *Skyknight* twin-jet fighter armed with Sperry *Sparrow* air-to-air guided missiles.

The U.S. Chance-Vought F7U-3 *Cutlass* naval jet fighter.

at certain Pacific and Atlantic bases. It reaches a speed of Mach 3, or approx. 1,000 m/sec.

The surface-to-air missiles available to the U.S.Navy include the *Terrier,* guided on a beam, and a more powerful anti-aircraft missile, the *Nike,* developed jointly by Douglas and General Electric. However, these anti-aircraft rockets take a very long time to perfect, and at the moment aircraft carriers must rely primarily on medium-calibre artillery, most of it carried aboard escorting anti-aircraft cruisers.

To sum up, the conditions under which the aircraft carrier can survive the general use of atomic weapons at sea are:

— fighter defence at a distance, with warning of approaching raiders extended through heavy early warning aircraft;

— close air defence by anti-aircraft artillery and guided missiles;

— dispersion of targets to minimize damage from atomic attacks.

N.A.T.O.'s Modern Naval Fighters, Attack and Patrol Bombers

Carrier-based fighters

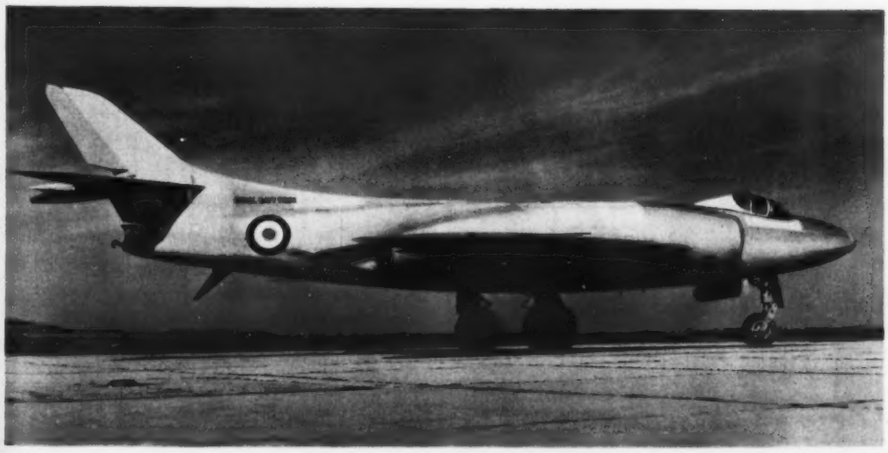
De Havilland Sea Venom(U.K.)
SNCA du Sud-Est Aquilon (Sea Venom licence; F)
De Havilland D. H. 110 (U.K.)
Hawker Sea Hawk F. 2 and FB. 3 (U.K.)
Vickers-Supermarine (derivative of the 525 experimental type; U.K.)
Chance-Vought F7U-3 Cutlass (U.S.A.)
Douglas F4D-1 Skyray (U.S.A.)
Douglas F3D-2 Skyknight (U.S.A.)
Grumman F9F-8 Cougar (U.S.A.)
North American FJ-2 and FJ-3 Fury (U.S.A.)

Naval attack aircraft and patrol bombers

Avro Shackleton 3, four-engined patrol bomber (U.K.)
Fairy Gannet, single-engined anti-submarine aircraft (U.K.)
Short Seamew, single-engined anti-submarine aircraft (U.K.)
Douglas AD-5 Skyraider, single-engined low-level attack aircraft (U.S.A.)
Douglas A4D-1 Skyhawk, single-engined low-level attack aircraft (U.S.A.)
Douglas A3D-1, twin-engined bomber (U.S.A.)
Lockheed P2V-1 Neptune, twin-engined patrol bomber (U.S.A.)
Martin P5M-2 Marlin, twin-engined long-range reconnaissance flying boat (U.S.A.)

There remains the question of protecting aircraft on the flight deck from the blast and heat of near misses. The solution is the double-deck aircraft carrier, with the take-off deck on the lower level and the landing deck above. This was the formula adopted in the *Furious* of 1925 and in the Japanese *Kaga* class carriers of 1928. In a modernized version, the aircraft would be catapulted straight from the hangar, and two lifts at the sides of the deck would remove aircraft immediately after landing. The two decks would eliminate the necessity for an angled deck.

The Vickers Supermarine 525 is a new British experimental naval fighter from which a long-range all-weather fighter is to be developed for the Royal Navy.



The aircraft carrier of tomorrow will have to avoid ports exposed to A-bomb or H-bomb attack and to remain at sea much longer in order to retain its mobility. Atomic power plants (planned for the third *Forrestal*-class carrier) will endow the carrier with an unlimited endurance, enabling it to collect supplies of aircraft and ammunition in ports or moorings beyond the range of the enemy's atomic weapons.

Atomic propulsion thus helps the aircraft carrier to survive in the atomic age.

"NEW LOOK" IN WEAPONS PLANNING — I

"New Look" in weapons planning?—Whereas under the age-old principles of yesterday means of offence and of defence formerly kept pace with one another, today—after a decade of atomic bombs—defence has lagged behind. On both sides of the Iron Curtain tactical and strategic atomic weapons, rockets and bombers are piling up. But what is being done to counter such threats by decentralizing or burying the armament industry, by safeguarding lines of communications or air bases?

Proposals are not wanting, and it is puzzling why only hesitating steps have been taken to put them into practice. The following texts discuss one of the most urgent problems and list the possible technical solutions.

Reducing the Size of Take-off and Landing Bases

The general introduction of jet propulsion and high-load thin wings has increased the dependence of fighter units on concrete take-off and landing runways to a dangerous extent. The danger is that these miles of runways, almost impossible to camouflage, are extremely vulnerable even to conventional bombs, let alone atomic weapons. A few well-aimed surprise hits are sufficient to pin a fighter unit to the ground for several days. A few direct hits would also suffice to make it impossible for returning fighters to land.

It is generally known that N.A.T.O. has built about 80 new concrete bases with runways up to 8,000 ft. in length and taken over another 80 existing major airfields for the approximately 2,400 jet-powered first-line fighters and fighter-bombers in Western Europe. A system of pipelines connects these bases direct with the French Atlantic ports. The network of bases and their pipelines will not be completed before the end of 1954, but it can be taken as certain that all bases are already accurately marked in the Eastern *bloc's* staff maps.

What part these concrete bases would play in the event of war is disputable. The aim may perhaps have been to create ideal jumping-off conditions for the air cover for a "defensive offensive". However, the opposite case is also conceivable. This costly infrastructure may be used only for "delaying action" during the first few days of a conflict, after which the West's whole remaining air power would be withdrawn behind the Pyrenees and the Alps and to the British Isles. On the other hand it would appear impossible—under present conditions—for the European front line in a shooting war to remain for long where it has become fixed during the "cold" war; i. e., along the Iron Curtain. One reason why this would be impossible is that most of Western Europe's industrial and communications centres lie within range of Russian rocket launching ramps.

This situation, aggravated by the fact that two standard concrete runways 8,000 ft. (2,450 m.) in length cost as much as a modern fighter squadron, has caused military and engineers, particularly in France—apprehensive because they would be close to the front—to sit up. "*More fighters or more concrete?*" they ask. The military are concerned primarily about the *interceptors* essential for safeguarding local air supremacy, and then about *fighter-bombers*. Most of these aircraft would have to go "under cover" in times of "phony" peace if they were to survive the first day of war. Nobody has suggested yet that the same should be done for all-weather fighters and jet-powered bombers, for which concrete runways and radio landing aids would still appear to be essential.

Wanted ... a new weapons system

Methods of protecting fighter units and their ground organization have been under investigation for years in France, Britain, Sweden and Switzerland. In essentials they involve radically reducing the areas required for take-off and landing and leaving them as far as possible in their natural state (woods, meadows etc.). This would simplify the camouflaging of bases and reduce the enemy's chances of scoring direct hits. Last but not least, efforts are being made to find a way of camouflaging the movement of aircraft on the ground and providing them with bomb-proof shelters. In other words, what is needed is an "integrated weapons system" of the kind previously discussed in these pages.[1]

[1] *cf. P. M. Gallois: "The Weapons System — A New Concept in Aircraft Production"*, in No. 12, 1953, p. 719.

Underground positions for interceptors (Saab J 29) in Sweden... provisionally without take-off catapults.

Method S. 1. (see table): twin undercarriage with low pressure tyres (44 p.s.i.) built by Société Messier (France). Skid between each pair of wheels comes into action if tyres are damaged; skin reinforcement on bottom of fuselage.

Method S. 1: This Dassault MD 450 *Ouragan* jet fighter can take off and land on any auxiliary airfield thanks to its Messier twin-wheel undercarriage. Landing run is cut down to less than 2,600 ft. by a brake parachute (method L. 1), which holds the nose wheel in the air during the first run-out phase.

Method S. 2: An Arado Ar 234 A twin-jet armed reconnaissance aircraft (built in 1943) leaving its take-off trolley, which is immediately brought to a standstill by a brake parachute. – Landing on a central skid beneath the fuselage (method L. 3); auxiliary skids underneath the engine nacelles and at the fuselage rear.

The new weapons system would have not only qualitative but also quantitative tasks to fulfil: one swallow has never made a summer. A single fighter, or even several dispersed wings, would be powerless in the sky. Therefore all organization and planning must be based on employment of the basic tactical unit, the *fighter squadron*. This unit, which today consists of 16 aircraft (four flights of four), must be able to formate within two minutes and land within the same space of time. Take-off and landing bases can be separate and split up into small areas. For example, there could be four catapults (or eight take-off tracks) for take-off, and four landing grounds, e. g., each measuring 1,000 × 1,000 ft. (300 × 300 m.), for arrester hook or skid landings.

Take-off and *landing*, however, are but two phases of operation, though the most striking. It is just as important to create reliable, not easily vulnerable structures and equipment for *ground movements* of aircraft; i. e., for all processes between the landing of a formation after a completed mission and the next take-off: clearing the landing area, taxying or transport to parking areas, replenishing fuel and ammunition, preparing for take-off.

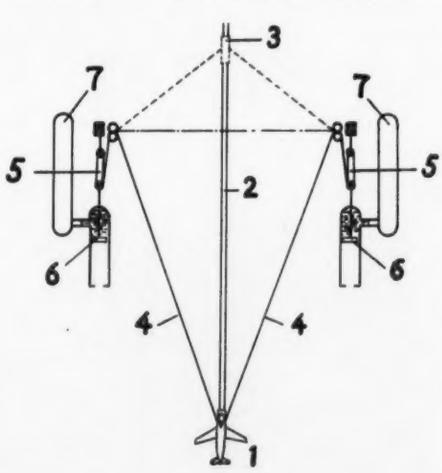
The following survey describes *ten* methods of reducing and camouflaging take-off areas, *seven* for landing areas and *four* methods of handling aircraft on the ground. In all 21 cases it is assumed that 16 aircraft operate simultaneously. These methods—and several others—can be combined among themselves, so that there is a great number of ways of operating interceptors or fighter-bombers from cover.

Take-off aids

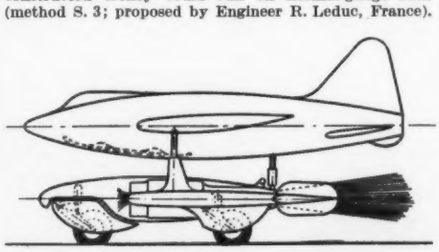
A word first on lengths required for catapult tracks and launching ramps and on take-off aids. For *horizontal* take-off the guide length must be great enough for the fighter to have reached its minimum flying speed when it leaves the installation; for *vertical* take-off, however, the guide system need only be long enough to ensure that the control surfaces become aerodynamically effective. Although it is of advantage to keep these guide lengths down to a minimum, it will scarcely be possible for physiological reasons, to plan on take-off accelerations of more than 4 g for piloted aircraft. With such an acceleration a fighter will reach a speed of 77.5 knots within one second (after covering 65 ft. = 20 m), of 155 knots within 2 seconds (after 262 ft. = 80 m.) and of 194 knots within 2.5 seconds (410 ft. = 125 m.). The first length (65 ft.) should as a rule suffice to get minimum control surface efficiency in *vertical take-off*. Take-off rockets, however, remain attached to the fighter and are jettisoned at a somewhat greater altitude, after which they continue to climb (more slowly) and finally land by parachute. The second value (262 ft.) would be needed for a horizontal take-off by a normally loaded jet fighter, with another 50 to 100 % of this distance probably being required for braking the trolley after the aircraft has left it. The third value (410 ft.) plus very considerable extras for braking the trolley would be necessary only for the horizontal take-off of heavily-loaded ramjet fighters (Leduc etc.) from normal-gauge rails.

To accelerate an interceptor weighing 6 tonnes for 2 seconds at 4 g needs a momentum of 4 × 6t × 2 secs. = *48 sectons* for a horizontal take-off (ignoring the aircraft's own thrust), or of 5 × 6t × 2 secs. = *60 sectons* for vertical take-off. Propellant consumption (for an exhaust velocity of 2,000 m/sec.) would thus be roughly 530 lbs. (240 kg) and 660 lbs. (300 kg.) respectively per aircraft take-off. Powder rockets and even "cold" and "hot" liquid rockets based on hydrogen superoxide (as used in the V1 catapult) would thus be much too costly. On the other hand the "Salbei-Tonka" combination (nitric acid as oxidizer, xylidine and triethylamine as fuel), developed by BMW in Germany during the war, would be a relatively cheap and efficient catapult propellant at a cost of 45 cents per lb. Even then a horizontal take-off by a squadron of 16 would still cost roughly $ 4,000. Further reduction in the cost of take-off assistance can only be obtained by using electro-magnetic catapults (Westinghouse) or catapults driven by compressed air, steam or the like. This, however, raises installation costs and increases vulnerability of the ground equipment. Mobility of units would also be seriously handicapped.

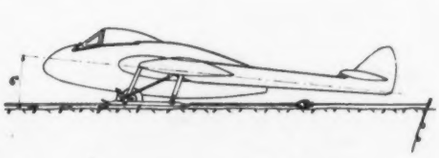
Method S. 4: Principle of the *Arbalète* cable catapult designed by Engineer Fieux (France). 1 = aircraft on take-off trolley; 2 = normal-gauge rails; 3 = trolley in final position (fully braked); 4 = V-shaped cable; 5 = block and tackle; 6 = shock absorber; 7 = gas generator.

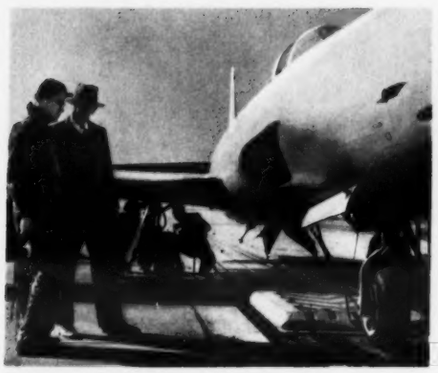


Method S. 2 (and S. 3): Cross-country rocket-powered take-off trolley (method S. 2) as proposed by Engineer M. G. Renollaud (Société D. O. P., France). A similarly constructed trolley could run on normal-gauge rails (method S. 3; proposed by Engineer R. Leduc, France).

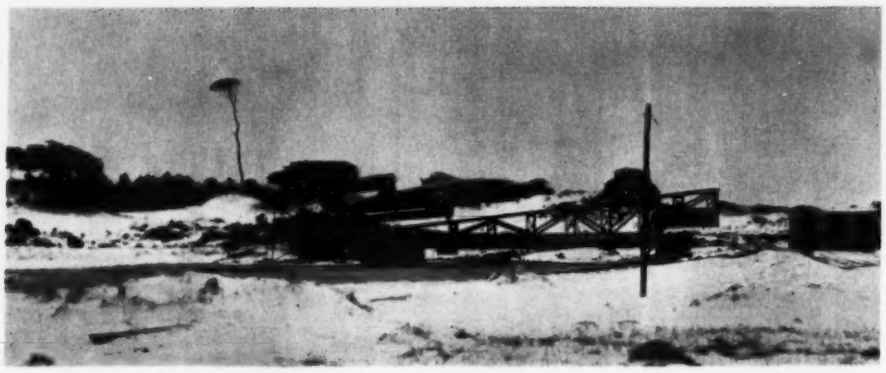


Method S. 5: Unassisted take-off on skids and rope guides (lubricated with kerosene), proposed by Engineer M. G. Renollaud (D.O.P.). The taxi trolley (shown here as wheel) for ground manoeuvring (method M.2) is removed before take-off; landing on skids (method L. 3).





Method S. 6: Westinghouse's "Electropult" at the Naval Air Test Center, Patuxent River, Maryland, with Lockheed F-80 jet fighter in take-off position. The centre strip of the track serves as wound-out rotor of an asynchronous motor and the 5 ½-inch high shuttle car which runs over it acts as stator.



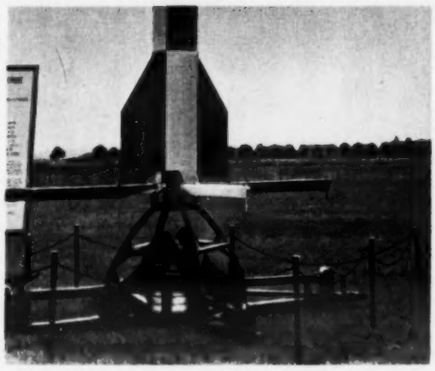
Method S. 7: Mobile ramps for pulse-jet-powered air torpedoes at Santa Rosa Island (U.S.A.) with American V-1 (or JB-2) ready for launching on the rocket take-off sled. A powder or compressed air catapult for a piloted fighter would be similar, except that it would have to be about four times as long because of the lower permissible take-off acceleration.

METHODS

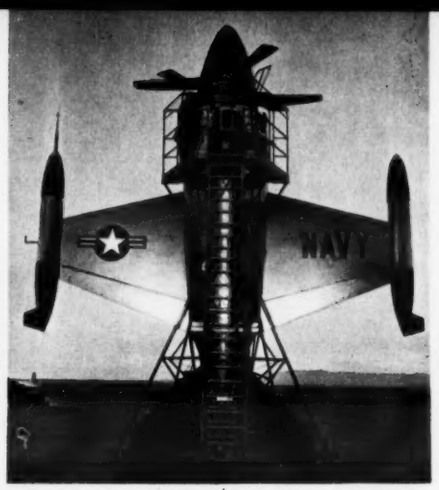
of take-off, landing and ground handling for a partially (to fully) protected fighter squadron (16 aircraft): take-off and landing of the full squadron must in all cases be completed within two minutes, though ground handling may take a little longer.

No.	Method	Proposed by	Number and type of ground equipment	Ground area required (sq. yds.)	Serviceability after air raids	Possibility of camouflage	Mobility of ground equipment	Remarks
S. 1	Unassisted take-off on multi-wheel undercarriage (low pressure tyres)	Messier	no special equipment	4 × 1,100 × 50 = 242,000 sq. yds.	slight	moderate	good	Long level airfield required.
S. 2	Take-off trolley on low pressure tyres (with rockets)	Arado SNCASE D.O.P.	16 trolleys 1 ton propellant	8 × 875 × 55 = 2 × 192,500 sq. yds.	slight	good	moderate	Braking run of about 330 yds. for trolley; 2 fields 220 × 875 yds. can be used.
S. 3	Rocket trolley on rails	Leduc	4 normal gauge rails 16 trolleys 4 tons propellant	4 × 330 × 16 = 4 × 5,280 sq. yds.	good (only chance hits)	good	moderate	Four tracks; ground equipment transported by railway for transfer of units.
S. 4	Catapult take-off on trolley and rails	Fieux	8 rails 8 catapults 8 trolleys 4 tons propellant	8 × 165 × 16 = 8 × 2,640 sq. yds.	good (only chance hits)	very good	moderate	Eight tracks; ground equipment transported by railway.
S. 5	Unassisted take-off on skids and ropes (with take-off rockets)	D.O.P.	4 rope "rails" 16 trolleys 1 ton propellant	4 × 875 × 16 = 4 × 14,000 sq. yds.	good (only chance hits)	good	good	Four tracks; road transport for take-off aids; erection 5 hours; dismantling 4 hours.
S. 6	Electropult	Westinghouse	1 Electropult 16 shuttle cars 1 power station	440 × 16 = 7,040 sq. yds.	doubtful (as very sensitive)	good	zero	Very costly; requires large quantities copper and own power station.
S. 7	Catapults	—	4 catapults (compressed air, steam, propellant or powder)	4 × 65 × 16 = 4 × 1,040 sq. yds.	very good	very good	slight	Catapults can be transported by road or rail; but fixed underground equipment required.
S. 8	Vertical take-off from rigs	Bachem	16 rigs 4 crane trucks 16 booster rockets 5 tons propellant	16 × 300 sq. yds.	very good	good	slight	Length of rig (15 to 33 yds.) determines mobility. Booster rockets can be re-used.
S. 9	Vertical take-off with cable guidance	Laboratoires de Vernon	16 take-off platforms 4 crane trucks 16 booster rockets 5 tons propellant	16 × 300 sq. yds.	very good	very good	moderate	Longer guidance than for S. 8, to give lower take-off acceleration.
S. 10	Free vertical take-off	Convair Lockheed	4 special vehicles 16 ladders (1 ton propellant)	16 × 300 sq. yds.	very good	very good	very good	Method under test, at present applicable only to turboprop fighters of inadequate speed.
L. 1	Brake parachute (and multi-wheel undercarriage)	—	32 spare parachutes	4 × 1,100 × 55 = 242,000 sq. yds.	slight	moderate	very good	Folding of parachute after landing very time-consuming.
L. 2	Thrust reversal (and multi-wheel undercarriage)	SNECMA Fairchild Boeing	no special equipment	4 × 550 × 55 = 121,000 sq. yds.	moderate	good	very good	System under test; promising.
L. 3	Landing skids (with claws)	SNCASE D.O.P.	16 jeeps 16 taxi trolleys	16 × 330 × 55 = 290,400 sq. yds.	good	very good	moderate	As it takes time to free the landing runway, several grass tracks are required.
L. 4	Cables, arrester hooks, normal undercarriage	Aircraft carriers Swedish Air Force	8 × 4 cables and shock absorbers 8 barriers	330 × 330 = 108,900 sq. yds.	good	very good	good	Simultaneous landing of 8 fighters; cables must be moved frequently (wind direction).
L. 5	Cables, arrester hooks, rubber carpet	Royal Navy	16 cables 16 carpets (4 crane trucks)	16 × 110 × 55 = 96,800 sq. yds.	very good	very good	slight	16 separate surfaces connected by taxiways; at least 4 crane trucks.
L. 6	Free vertical landing	Convair Lockheed	16 rope ladders (4 special vehicles)	16 × 480 sq. yds. (concrete)	very good	very good	very good	System *not yet tested;* at present only for turboprop fighters of inadequate speed.
L. 7	Parachute landing	—	16 rope ladders 32 spare parachutes (16 special vehicles)	(emergency grounds)	very good	very good	slight	High risk of damage; time-consuming recovery; hence large aircraft reserve needed.
M. 1	Independent taxying on own undercarriage (low pressure tyres and/or controllable skids)	Messier D.O.P. SNCAN	no special equipment	large grass field (or broad taxiway)	slight (good)	moderate (very good)	good	Can be combined with S. 1 to S. 9 or L. 1 to L. 5.
M. 2	Taxying on trolley (with own power plant and/or jeep)	SNCASE D.O.P.	16 jeeps 16 trolleys	small grass field (or taxiways)	good	good (very good)	moderate	Can be combined with S. 2 to S. 9 or L. 3 and L. 5.
M. 3	Removal by crane truck; independent taxying on own undercarriage or trolley	Royal Navy	4 crane trucks 4 trolleys	Taxiways	good	good	slight	Can be combined with S. 1 to S. 9 or L. 5.
M. 4	Recovery by special vehicles	—	16 special vehicles	Taxiways	good	good	slight	Can be combined with S. 1 to S. 10 or L. 5 to L. 7.

Method S. 8: Vertical take-off by a pilotless experimental model of the German Bachem BP. 20 *Natter* rocket fighter (four take-off rockets only; no power plant of its own) from a lattice rig about 65 ft. high (1945 in Württemberg).



Method S. 9: Vertical take-off installation with cable guidance, as proposed by Laboratoires de Recherches Balistiques et Aéronautiques, Vernon (France). The fighter is placed on the rocket (with guide cross) seen in the picture.



Method S. 10: Lockheed XFV-1 turboprop fighter for free vertical take-off, with access ladder. Its rival type, the Convair XFY-1 made its first tethered flight on June 2nd (pilot: J. F. Coleman), when it rose to about 65 ft. and landed again with engine running.

Methods of reducing take-off areas

Multi-wheel undercarriage with low pressure tyres (Method S. 1): This method has recently been taken up—for side-by-side retractable wheels—by Société Messier and tested on an MD. 450 Ouragan jet fighter (pictures). It needs a more or less level airfield, about 3,000 ft. long, which would of course have to be "re-levelled" after air raids. On the other hand it requires no special ground equipment, and the units thus retain a high degree of mobility.—Multi-wheel undercarriages with (non-retractable) wheels one behind the other have so far been used only in the giant Messerschmitt Me 323 transport, but have also been under study for some years by Etablissements Sciences Techniques (Vaduz), in the form of the Bonmartini caterpillar undercarriage.

Take-off trolley on low pressure tyres (Method S. 2): First used by Arado in 1943 (picture), this method has more recently been adopted, with additional take-off rockets attached to the trolley, in the SE. 5000 Baroudeur tactical aircraft (cf. **Interavia** No. 3, 1954, pp. 150 etc.). Another supporter of the method is Engineer M. C. Renollaud, Managing Director of Société D. O. P. (cf. AFITA lecture of June 20th, 1951: "Should undercarriages be abolished?").—To get a fighter squadron off the ground, 16 trolleys with brake parachutes and roughly one ton of rocket propellant—plus one or two take-off fields measuring about 2,400 ft. are required. The unit's mobility is moderate, but can be increased if the aircraft carry their trolleys along with them when flying to a new base.

Rocket trolley on railway track (Method S. 3): This method, a development of the previous one, is the one which Engineer René Leduc envisaged as take-off aid for his heavily-loaded ramjet aircraft. Its advantage would be that four narrow "departure lanes" (each about 50 ft. wide) per squadron would suffice. These would be easy to camouflage and difficult to hit. In this case the trolleys could be braked electro-magnetically on the rails after the aircraft have taken off, so that rails of about 1,000 (300 m) in length would normally be sufficient. Requirement of underground buildings and ground equipment, however, would be high: 4 rail tracks, 16 trolleys, 4 tons of rocket propellant . . . plus a variety of special equipment for handling the aircraft after landing at auxiliary fields in the neighbourhood. Mobility of the fighter unit is thus correspondingly restricted, since fundamentally it can only be moved by rail.

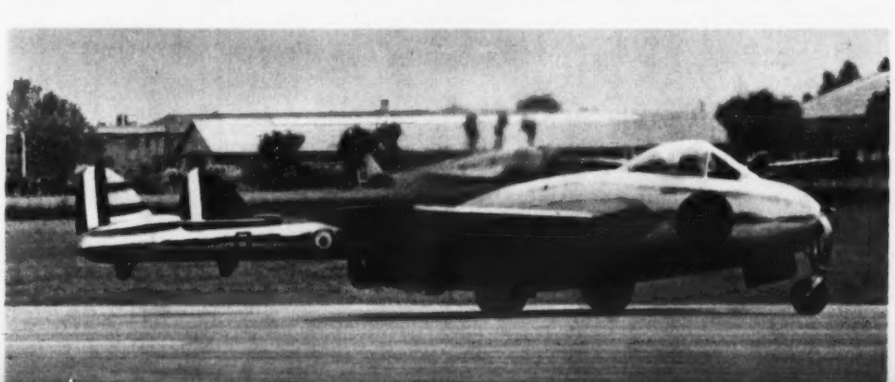
Catapult take-off on trolley and rails (Method S. 4): The principle of this interesting take-off method designed by Engineer Fieux is shown in the picture. The "cross-bow" ("Arbalète") system enables the trolley's braking run to be reduced considerably and thus needs a total length of no more than 500 ft. (150 m; cf. R. Arpurt: "Pour raccourcir les pistes"= "Shortening Runways" in **Forces Aériennes Françaises,** July 1952, pp. 505 etc.). On the other hand, even more ground equipment is required than in method S. 3, and mobility is therefore also less. The inventor proposes to **reverse** the process for landing, but this would appear to be doubtful in view of the major importance of the wind direction in any landing.

Unaided take-off from skids, with ropes (Method S. 5): Engineer M. G. Renollaud, an enthusiastic advocate of skid undercarriages, has yet another project, applicable to fighters and fighter-bombers: each aircraft would be moved on its own two-wheel "taxi support" to the "rope rails" laid out on the ground and there take off on its skids from the rope runway (picture). The ropes are about 3/8 inch thick and 875 yards (800 m) long, held taut at either end and braced to the ground by steel plates at intervals of 4 ft. So that the skids can remain on the ropes they have a groove along the centre, which is lubricated with kerosene during take-off (about 2.2 Imp. gals. per aircraft). Take-off rockets are used to reduce the run required. After take-off the skids are retracted, but lowered again for landing, whereupon another taxi trolley picks up the aircraft. Another variant of the system, now being tested by D. O. P. and SNCA du Nord, features controllable main skids and a normal low pressure nose wheel. If a more powerful turbojet is used (e. g., in a Mk 53 Mistral), the taxi trolley can be dispensed with and in some cases even the rope track. Divided into four runways 50 ft. wide, the ground installations would be easy to camouflage and almost impossible to hit from the air. Mobility of units (they can move by air or by road) is high.

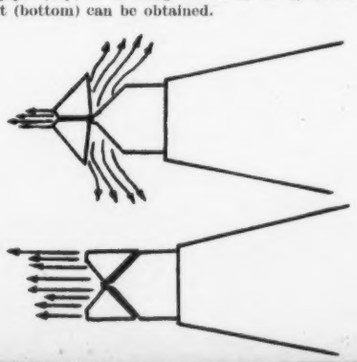
Catapult take-off by "Electropult" (Method S. 6) A detailed description of this very costly process developed by Westinghouse Electric Corp. (picture) was given in **Interavia** No. 5, 1948 (pp. 268 etc.). The "Electropult" uses large quantities of copper (and steel) for the take-off runway, and needs a 750 kW generator (with motor) and a 24-ton fly wheel to produce the tremendous peak power of 12,000 kW. On the other hand, its performance is impressive. A Lockheed F-80 Shooting Star, for example, can be brought up to its take-off speed of 118 m. p. h. in a 340-ft. run within four seconds. The catapult's maximum speed of 225 m. p. h. is reached after a run of approx. 1,382 ft. The shuttle car is braked electromagnetically within a few yards.—The Electropult, however, is completely immobile and is highly vulnerable to bomb splinters unless heavily protected.

Catapult systems (Method S. 7): This method has been in use for years in aircraft carriers where, owing to the latter's own speed (30 to 50 knots) catapults roughly 100 ft. long are sufficient for jet fighters. The cable from the gas pressure catapult is attached to the towing hook on the aircraft which is anchored in position, with engines running, by a retaining cable with safety ring. As the catapult goes into action the safety ring breaks, and the aircraft is accelerated to take-off speed in a bare two seconds. Power is supplied by compressed air or steam (cf. **Interavia** no. 3, 1954, p. 123); more recently smokeless powder has been under consideration (e. g., in Sweden). The catapults used for the German V 1 worked with

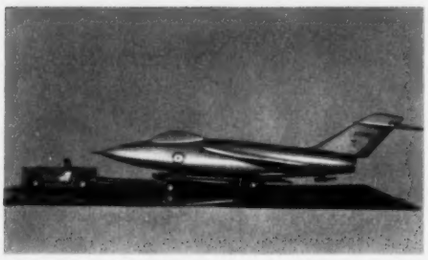
Method L. 2: Landing braking by the SNECMA thrust reversal system. The deviator consists of a series of reversal rings at the end of the tail pipe. The reversed thrust is discernible over the top of the *Vampire* fuselage.



Method L. 2: Braking the landing run by thrust reversal, according to a system designed by Fairchild Engine and Airplane Corp. (U.S.A.). By opening out the end of the tail pipe (top) a braking thrust of 40 % of normal thrust (bottom) can be obtained.



Method L. 4: Braking the landing of a de Havilland *Vampire* by the same system of 4 to 12 elastic cables (and arrester hook) used in aircraft carriers. Landing signals officer in foreground.



Method M. 2: Taxying on a trolley, with own engine power and/or jeep, as proposed by SNCA du Sud-Est (SE. 5000 *Baroudeur*).

Method M. 4: Lifting, transporting and lowering the Convair XFY-1 vertical rising turboprop fighter by means of a special vehicle (Convair).

highly-concentrated hydrogen superoxide. On land, catapult lengths would have to be at least 50% greater than aboard ship i. e., 150 to 200 ft. If the catapults are entirely or partially buried, operating reliability is very high; mobility of ground installations, however, is small, even if road transport of individual items is envisaged (picture).

Vertical take-off from launching rigs (Method S. 8): As mentioned earlier, a guide length of 62 ft. suffices as a rule (picture). Vulnerability is small, but the amount of ground equipment—rigs, rockets, crane trucks, ladders, propellant—is very substantial, which greatly reduces mobility.

Vertical take-off with cables (Method S. 9): As described by W. Pilz in **Interavia**, No. 11, 1953, the launching rig for vertical take-off can be replaced by a system of guiding cables 200 to 330 ft. long (picture), so that the acceleration of a manned fighter can be substantially reduced. Much the same amount of ground equipment is required as for method S. 8, though mobility is somewhat better.

Free vertical take-off (Method S. 10): This system, proposed by Lockheed (picture) and Convair (picture), was described in some detail in a recent issue of **Interavia** (No. 5, 1954). Still under test, the system can at the moment be applied only to turboprop fighters of medium speed. Whether it will prove satisfactory in practice remains to be seen. Vulnerability to air attack is very small, mobility—on cross-country trucks—excellent.

Methods of reducing landing areas and of ground handling

Here the most important methods have been known for a considerable time and can therefore be dealt with more briefly. This applies in particular to landing with brake parachute **(Method L. 1)**, skid landing with use of brake claws **(Method L. 3)** and "aircraft carrier landing" **(Method L. 4)**. For details of thrust reversal schemes **(Method L. 2)**, now under practical test by SNECMA (France) and the two American firms of Fairchild and Boeing, the reader is referred to earlier articles (primarily by K. Iserland, **Interavia**, No. 3, 1953) and to the pictures on the previous page.

A method of landing light fighters (and carrier lighters) on a pneumatic rubber carpet using arrester hooks and cables (with undercarriage retracted) tried out by Britain's Royal Navy **(Method L. 5)** raises the objection that enormous crane trucks would be required to lift the aircraft off the carpet immediately after landing, to make room for the next one.

The same applies to the "free vertical landing" **(Method L. 6)** as to the corresponding take-off method. It is probably applicable only to turboprop fighters, and has not yet been tried out in practice.—Finally, the "free parachute landing" of the complete aircraft (with engine cut off) by means of giant parachutes **(Method L. 7)** should most probably be regarded only as an emergency solution, not a regular landing method. As the actual point of landing cannot be selected, large cross-country salvage vehicles and a big reserve of aircraft would be needed.

Methods of handling aircraft on the ground are described in the table and illustrated in the last two pictures on this page. These four ground handling methods can be combined with practically all of the take-off and landing methods described above.

Optimum integration

What combination will ultimately be adopted by military, manufacturers and pilots cannot yet be forecast. Undoubtedly much will depend on topographical features. In mountainous country catapults will probably be preferred, compared with unassisted take-off in flat territory. Whenever possible, aircraft should be able to *taxi by their own means,* for which controllable skids, in conjunction with a powerful jet engine (proposals by SNCASE and SNCAN), may suffice. Only by "independent taxying" can landing grounds be cleared sufficiently fast for the next arrivals and the aircraft taken to cover immediately after landing.

What is clear, however, is that the passive defence of given fighter bases now claims a position of priority in view of the development of modern weapons of attack, and can no longer be neglected.

"NEW LOOK" IN WEAPONS PLANNING - II:

America's Flying Radiation Police

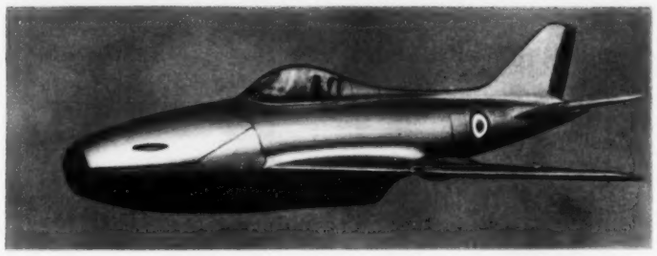
How was the Atomic Energy Commission able to discover and announce that the first nuclear explosion had taken place on Soviet territory in August 1949? The Russians had not said a word on the subject before President Truman told the world. And how could the A.E.C. immediately confirm Malenkov's statement on the Russian hydrogen bomb experiment (August 8th, 1953)? The answer to both these questions is: America's "Flying Radiation Police".

For some considerable time past the A.E.C. has had the Arctic and neighbouring areas patrolled by specially-equipped aircraft. Flying at very high altitude, the crews of these aircraft detect any atomic explosion within thousands of miles of their radiation counters. If measurements are taken simultaneously by several aircraft it should even be possible to ascertain the location of the explosion. The radiation police also carried out an exercise during the American H-bomb tests in the Marshall Islands this spring.

No details are known of the aircraft used for this atomic snooping service. They may be converted B-29 Superfortress bombers or, more probably, special versions of the Lockheed Super Constellation similar to the U.S. Navy's WV-2 early warning aircraft seen in the picture here.

"NEW LOOK" IN WEAPONS PLANNING — III:

The Problem of the Stripped Light-Weight Fighter



1: Model of the Aerfer-Ambrosini-Stefanutti *Sagittario II* (Rolls-Royce *Derwent* engine).

What kind of fighter and fighter-bomber can still be produced, equipped, armed and fuelled, in the second month of a war—and all the succeeding months—in relative proximity to the fighting front? The West's aircraft designers, production engineers and staff officiers have been studying the problem for years. Only aircraft that can be produced cheaply, simply and quickly, largely from non-strategic materials, obviously can enter into consideration. One point upon which the experts agree is that considerations of economy should not affect the performance of the aircraft in the rôle for which they are designed. Efforts have therefore been concentrated on providing specialized equipment for each individual operational rôle—target defence, ground support, etc. Furthermore, substantial reductions are made in design weight, the decisive production cost factor. The result of these efforts can be described as a "suitably stripped light-weight fighter."

As long as two years ago Interavia *raised some of the questions involved in the construction and operation of aircraft belonging to this new category (cf. No. 7, 1952: "Short-Life Aircraft"). The example of the German Heinkel He 162 "People's Fighter" of the last months of World War II shows what savings in weight, structural materials and cost can be effected even in a well-armed high-performance fighter. Meanwhile, several modern light-weight fighter types equipped with more efficient jet engines have been taken in hand. France's SNCA du Sud-Est has created the SE. 5000* Baroudeur *medium-heavy interceptor and armoured ground attack fighter (cf.* Interavia *No. 3, 1954), Britain's Folland Aircraft Ltd. is working on the FO. 141* Gnat *light interceptor and on a ground attack version (cf.* Interavia *No. 9, 1953 and No. 3, 1954), A. V. Roe & Co., Ltd., are designing a delta-wing light ground support aircraft, Lockheed Aircraft Corp. is building the F-104 medium-weight stripped fighter. Other "short-life fighter" projects are taking shape in the shops of Avions Marcel Dassault, SNCASO (SO. 9050) and SFECMAS. Finally, René Leduc and SFECMAS are working on ramjet-powered fighter prototypes.*

From Italy it is now learned that a stripped light-weight fighter is under development and is to be completed in the near future. Italy, a country without substantial raw material resources and with a low national income, is vitally interested in protecting her air space in times of war with an efficient but financially acceptable fighter produced in her own work-shops. All-weather fighting in the Sunny South poses fewer of the critical problems which arise in Northern regions such as the British Isles: for this reason day fighters cooperating with ground radar stations are regarded as adequate for Italy. Two years ago Società Aeronautica Italiana, Ing. A. Ambrosini & Co., completed a wooden experimental type to the designs of Dr. Sergio Stefanutti. This was the Sagittario I *and featured 45° wing sweep and a Turboméca* Marboré II *jet engine delivering about 900 lbs. static thrust.*

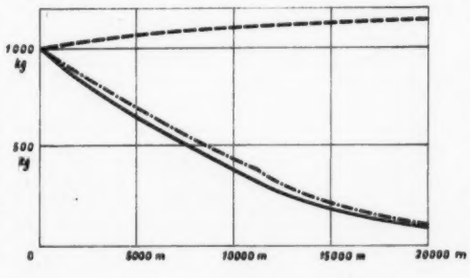
On the basis of experience gained with the experimental model, Officine di Pomigliano d'Arco per Costruzioni Aeronautiche & Ferroviarie *(Aerfer), a subsidiary of Società Finanziaria Meccanica (Finmeccanica) managed by Dr. Amadeo Carassai, is now developing several all-metal versions of a light-weight interceptor and ground support fighter suitale for quantity production.*

Italy's latest fighter type bears the designation *Aerfer-Ambrosini-Stefanutti Sagittario II* and will be powered by a Rolls-Royce *Derwent 9* centrifugal jet (fig. 1). The two-spar undivided wing unit of the *Sagittario II* has a leading-edge sweep of 45° and a low aspect ratio; it has boundary layer fences and a span of about 25 feet (7.5 m). The fuselage, about 33 feet (10 m) long, consists of four major assemblies: upper front fuselage, lower front fuselage, jet pipe housing, main fuselage shell with cockpit and integral vertical fin. The installation of the *Derwent 9* engine is similar to the arrangement which was adopted in the *Sagittario I:* the engine is mounted well forward, air intake is in the nose, jet pipe runs along fuselage underside from the wing root and exhausts below the wing trailing edge. This arrangement leaves the fuselage shell free for other installations: fuel tanks, guns, auxiliary rocket motor. The type has a retractable undercarriage, the nose wheel of which moves backwards and upwards into the lower nose section (No. 2 fuselage assembly), whereas the main wheels retract into the thrust pipe housing (No. 3 fuselage assembly). The one-piece stabilizer, fitted with two independent elevator halves, has the same leading edge sweep as the wing. — Equipment: pressurization, Martin-Baker ejector seat, two 30-mm cannon near the centre of gravity, sighting equipment, air-to-air and air-to-ground rockets, bombs according to military specification.

It is reported that several prototypes of two combat versions of the *Sagittario II* are under construction at the Aerfer plant at Pomigliano d'Arco:

- — *a short-range interceptor version* of substantially reduced all-up weight for very high rate of climb,
- — *a ground support fighter version* with rockets and bombs (on racks under the wing) and greater fuel capacity to satisfy N.A.T.O. specifications.

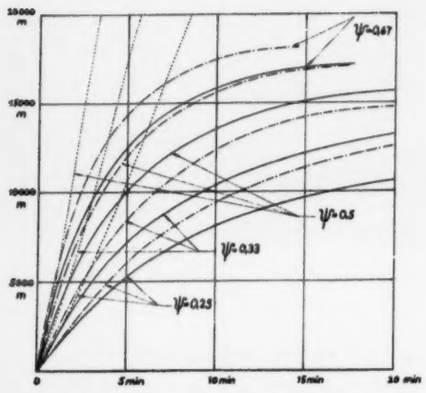
2: Variation in static thrust at growing height of the turbojet (unbroken curve), of the turbojet-plus-reheat (dot-dash curve), and of the rocket motor (broken curve). In all three cases the basic static thrust is 1,000 kg (2,200 lbs.) at sea level.



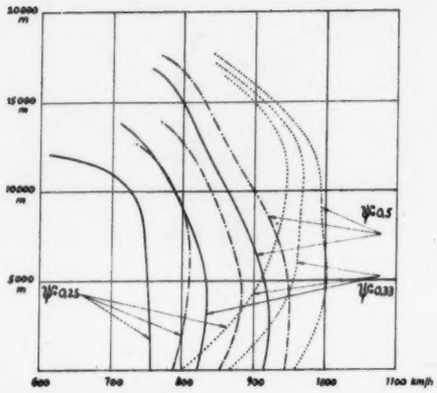
Data and estimated performance figures are classified for the time being. On the other hand, it is possible to report on the design criteria which led to the creation of the *Sagittario II.*

Preliminary studies

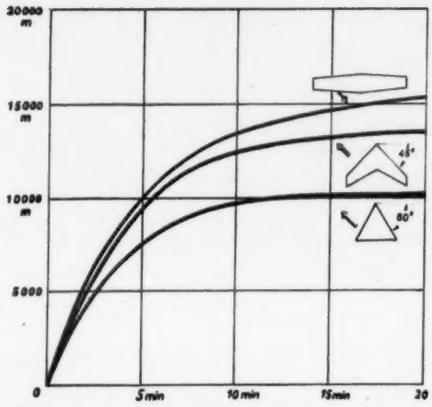
The basic criterion for design of a stripped light-weight fighter consists of the minimum performance which is required for the short-range interception of modern jet bombers:



3: Climb performance of a straight-wing short-range interceptor with a wing loading of 300 kg/m² (61 lbs./sq.ft.) with different types of power plant (turbojet = unbroken line; reheat = dot-dash line; rocket = dotted line) and different thrust-weight ratios Ψ. The altitude reached (in metres) is entered above the time of climb (in mins.).



4: Variation in maximum level speed of a straight-wing short-range interceptor of 200 kg/m² (40 lbs./sq.ft.) wing loading with different types of power plant (turbojet = unbroken line; reheat = dot-dash line; rocket motor = dotted line) and different thrust-weight ratios.



5: Effect of wing planform on climb performance of a short-range interceptor with identical turbojet (Ψ = 0.5) and identical wing loading (250 kg/m² = 50 lbs./sq.ft.) in all cases. Again the altitude attained (in metres) is entered above the time of climb (in minutes).

— Less than 10 minutes to climb to combat height of about 40,000 ft. (12,000 m).

— Maximum speed with short-period emergency power at combat height 15 to 20 % greater than speed of bomber, i. e., about 700 m.p.h. (1,100 km/h).

— Altitude manoeuvrability permitting centrifugal acceleration up to 3 g without loss of height or compressibility difficulties.

In the face of these minimum requirements and the present state of aircraft engine development, Aerfer and SAI-Ambrosini came to the conclusion that to build a modern *jet-powered interceptor of all-up weight of three to four tons* was well within the realm of possibility. If rocket power were employed, all-up weight would rise to four or five tons because the higher rate of fuel consumption of the rocket more than offsets the engine weight saving obtained.

As regards the configuration of the aircraft the designers had the choice of three "classical" solutions—straight, swept or delta wing. Their decision was greatly influenced by the thrust ratio at combat height (thrust to gross weight) and was closely related to the choice of power plant. On the basis of the projected take-off weight several solutions were investigated from the following angles:

— Type of power plant

— Thrust ratio at take-off

— Wing loading

— Aerodynamic configuration.

Power plant: As fig. 2 shows, there is a substantial difference between the turbojet engine and the rocket motor as regards altitude performance. Whereas the thrust of a rocket motor increases with altitude—at 40,000 ft. it is about 10 % better than at sea level—the thrust of the turbojet, with or without reheat, drops in roughly the same proportion (about 67 %) as the density of the atmosphere (about 75 %).

Thrust ratio: Study of climb and speed performance (fig. 3 and 4) was based on the take-off thrust ratio. Though rate of climb and ceiling of the rocket interceptor appear to be particularly favourable, the diagram should deceive no one. The turbojet-powered short-range interceptor will attain higher take-off thrusts than the rocket fighter, though it must content itself with lower combat heights.

Wing loading: The general tendency is to keep wing loading as low as possible, provided this is compatible with other vital considerations. Investigation of the effect of wing loading on performance with different types of power plant and thrust ratios produced the following picture: in the *turbojet-powered* fighter with a low thrust ratio (0.25) wing loading has a major effect on rate of climb. With a moderate thrust ratio (0.5) it merely affects the ceiling but not the rate of climb. In the *rocket-powered* fighter the effect of wing loading is negligible over a wide margin of the climb.

Aerodynamic configuration: The effect of the different wing shapes on climb performance is illustrated roughly in fig. 5. Obviously, other factors also had to be taken into account in this study, particularly aspect ratio and thickness ratio. With identical wing loading and thrust ratio the transition from straight wing to swept or delta wing is accompanied by the following phenomena: impaired climb performance; unfavourable stall characteristics; improvement of critical Mach number. *Stalling speeds and compressibility critical speeds* of the three wing shapes are shown in fig. 6. The general conclusion is that the most suitable wing configuration must combine optimum climb and adequate critical Mach number, taking into account in both cases the available engine thrust.

*

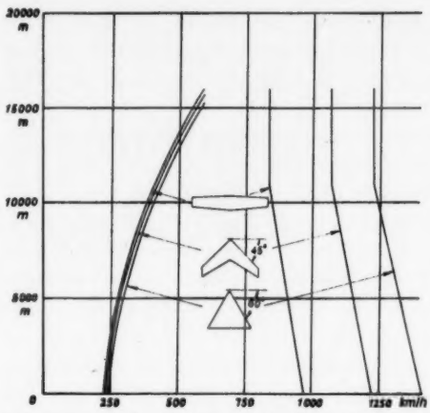
The engine industry today produces medium-power turbojets whose weight amounts to only about 35 % of maximum thrust. If a combat load is chosen which is carefully adapted to the specific combat rôle, it is possible to build a *turbojet fighter* whose sea level thrust ratio with the turbojet alone is better than 0.5 and with reheat reaches at least 0.6. As regards wing loading and, thus, size of the aircraft, a figure of about 50 lbs./sq. ft. (250 kg/m²) seems suitable. The wing area of the fighter would therefore amount to about 160 sq. ft. (15 m²).

The chosen thrust ratio is relatively high only at sea level but quite low at combat height. It necessitates a greater degree of *wing sweep* which forces the compressibility limit upwards in high-speed flight without producing any substantial drop in climb performance. Fig. 7 shows the estimated performance of such a fighter type. The diagram indicates that rate of climb and minimum speed are satisfactory only at low and medium altitude but fall off rapidly at very great heights. This solution can therefore be adopted only so long as enemy bombers approach at altitudes of 40,000 feet or less. On the other hand, the comparatively low fuel consumption—provided that reheat is not used excessively—guarantees a satisfactory endurance, which enables this aircraft type to be operated also for missions other than short-range interception.

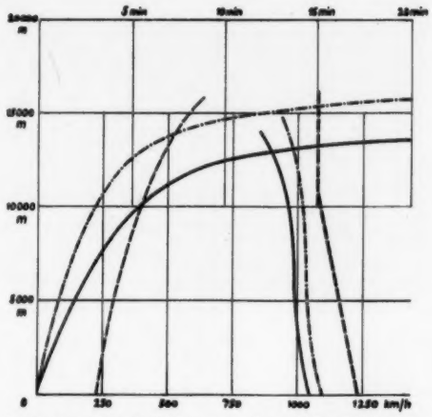
Present rocket motors also make it feasible to build a *rocket-powered fighter*. Such an aircraft would attain a take-off thrust ratio of 0.4 and a combat level thrust ratio of 0.6 (improvement in thrust and reduction in gross weight). The *delta-wing* configuration would have to be adopted in order to improve performance at altitude. However, the high specific fuel consumption—approximately 11 lbs. per secton—presents considerable difficulties. For a thrust identical to that of the turbojet, 15 or 20 times the fuel quantity would be required. Though taking into account the greater volumetric capacity of the rocket fighter (small size of power plant) and high take-off weight, it can be stated with certainty that total endurance will not exceed 10 minutes. Nevertheless, interest in this category of fighter will waken as soon as bomber operating levels show a further increase.

Advantages of combined power plant

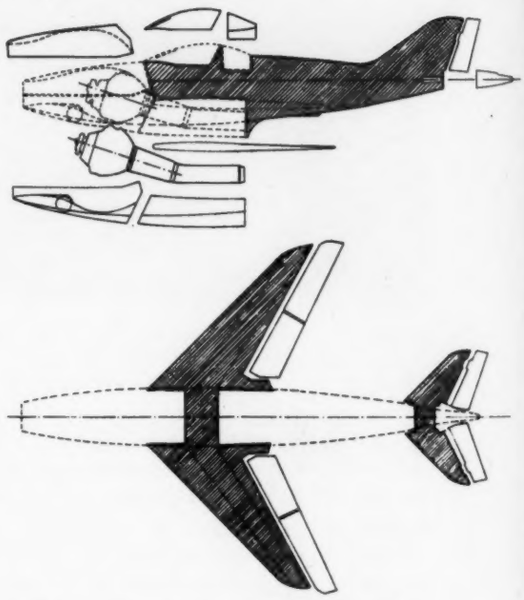
Combination of turbojet and rocket motor offers the advantages of both solutions and eliminates some of the disadvantages. The following possibilities exist:



6: Minimum speeds and critical maximum speeds of short-range interceptors with different wing configurations. The minimum speed is determined by the maximum lift of the wing, the critical maximum speed by the wing's limiting Mach number.



7: Speed and climb performance of a turbojet short-range interceptor of 250 kg/m² (50 lbs./sq.ft.) wing loading with and without reheat. The first case (dot-dash curves) is based on a $\Psi = 0.6$ thrust ratio, the second (unbroken curves) on a $\Psi = 0.5$ ratio. Critical maximum and minimum speeds (broken curves) remain independent of the type of power plant.



10: Major assemblies of Aerfer-Ambrosini-Stefanutti *Sagittario II* stripped fighter, plan and side view. Fuselage consists of four assemblies; wing and stabilizer are one-piece structures.

1—The turbojet is the normal power plant, and the rocket motor operates only in emergencies, i. e., in combat.

2—The rocket motor is the main power plant, climb and combat included. An auxiliary turbojet enables the pilot to return to base after completing his mission.

In principle, the first solution is equivalent to improving the performance of the turbojet fighter by means of an afterburner, whereas the second is an adaptation of the rocket fighter to practical requirements. From the aerodynamic angle the two types of combined power plant fighters would correspond to the basic configurations mentioned earlier.

Considerations valid for the pure rocket fighter are applicable also to the rocket-propelled fighter fitted with an auxiliary turbojet: the very high fuel consumption renders operation of such fighters difficult. All the same, the combined power plant presents many a temptation to the aircraft designer: it forms a means of combating even "bombers of the immediate future" with light-weight fighters.

The engineer is forced to provide very large containers for fuel and oxidizer. Furthermore, it is necessary to direct the rocket thrust line through the aircraft's centre of gravity, even at the cost of discarding the same principle for the turbojet.

To increase propellant capacity external auxiliary tanks can be used. Alternatively, novel fuselage design principles to improve utilization of available fuselage volume might be adopted. The following solutions are possible to place the rocket thrust line through the aircraft centre of gravity:

—Division of the turbojet pipe into two halves placed symmetrically and parallel to the longitudinal axis, location of the rocket motor between these halves.

—Location of the turbojet below the aircraft centre of gravity.

Design principles of the Sagittario II

After protracted investigation the *Sagittario's* designers came to the conclusion that use of the turbojet as the main power plant—augmented by an auxiliary rocket for emergencies—would provide the best and most economical solution to the propulsion problem in a light short-range fighter, since there is no reason to believe that within the foreseeable future bombers will fly at altitudes making the use of rocket-propelled fighters imperative. Also, turbojet propulsion is much cheaper than rocket propulsion. Finally, only turbojet fighters are additionally suitable for other military assignments, e. g., ground support, for only they possess the required endurance.

Particular importance was attached to ensuring that the rocket motor and propellant tanks could be exchanged for additional turbojet fuel tanks by means of a few simple manipulations capable of being carried out at military field maintenance stations. The aim of this requirement was to give the fighter longer range at low operating levels.

In their search for methods of making optimum use of the fuselage volume, the designers hit on the engine arrangement which is characteristic of the *Sagittario:* engine mounting in the nose, jet exhaust under the fuselage. As a result, a very large portion of the fuselage volume is available for fuel tankage. Moreover, the rocket motor can be fitted in the tail and aligned so that the thrust line passes through the aircraft's c. g.

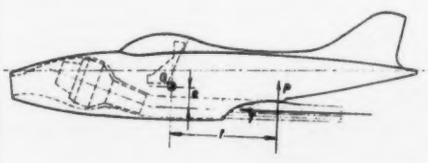
The difficulty of this solution lay in the effect of the eccentrically acting turbojet thrust on longitudinal stability. It was eliminated by a simple geometrical modification to the upper half of the jet pipe nozzle (fig. 8).

As regards armament—ultimately the main feature of a fighter—firearms of great destructive power had been selected *ab initio,* namely, *30-mm cannon with a barrel length of 60 to 70 calibres and a high rate of fire.* Owing to their substantial recoil forces these guns are mounted centrally in closest proximity to the aircraft's c. g. and braced against heavy members of the fuselage structure.

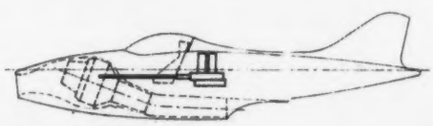
The simple design of the *Sagittario II* (fig. 10) makes the type specially suitable for quantity production: the one-piece wing passes under the fuselage structure, so that the wing-fuselage attachment fittings have to transmit only relatively light loads. The wing structure is not weakened by the main wheels, which retract into the fuselage. The landing gear is short and therefore light. Since the engine, which needs frequent servicing and maintenance, is in the readily accessible fuselage nose, the remainder of the fuselage, including cockpit and fin, can be built integrally in one piece.

In addition to the centrifugal compressor type Rolls-Royce *Derwent* 9 engine, consideration was given to the use of axial-compressor type power plants. The designers of the *Sagittario II* believe, however, that the simpler design and lower cost of centrifugal-compressor engines more than compensate for the smaller fuel consumption of axial types, particularly in a low-cost mass-production fighter.

8: Automatic longitudinal moment compensation of the eccentric thrust of the *Sagittario II* by the introduction of a vertical component $T \times e = P \times f$ acting on the upper half of the jet nozzle.



9: Armament of the *Sagittario II* – two 30-mm cannon – is located in the immediate proximity of aircraft centre of gravity. Gun mounts are braced against heavy members of fuselage.



The Air Hostess Told Us...

N.A.T.O. issue? mocks Esmeralda, our Favourite Air Hostess, you make me laugh. Without my timely help, your issue would be a mere comic strip.

Go away, honeybelle, we say, we don't want any of your feminine chatter, we're going to press. Oh no, you don't, says Esmeralda, because I have some super-cosmic-secret information which even Senator McCarthy doesn't know and which will make N.A.T.O. the biggest, strongest, most tremendously mighty power, capable of inflicting peace on everybody whether they want it or not.

From the top of her stocking (some girls persist in the illusion that this is an inaccessible hiding place) she pulls a document, and we read:

"Dear Esmeralda,

From 'INTERAVIA' I have your honoured address and beg you for your esteemed attention.

I have complete plans for a jet bomber which according to calculations, for example, breaks through the sonic wall in horizontal flight. Maximum speed is Mach 1.8, climbing speed about 300 m. p. h. from sea level to 40,000 feet. Ceiling is 82,000 feet. In case of keener interest on your part further data of the machine will naturally be placed at your disposal.

I personally know everything about aircraft engineering and have worked two years on the above plans. Please give me the addresses of various concerns who would be interested in studying my plans in greater detail.

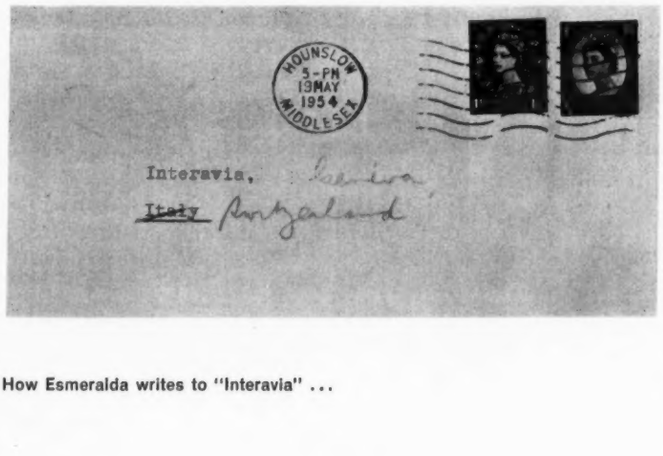
Yours respectfully, H. B., Zurich."

What did I tell you? asks Esmeralda. Yes, yes, we said, we'll phone Generals Eisenhower and Norstad and Sir Winston Churchill and Douglas, Lockheed, Vickers and Count Zeppelin. And now, we added with dignity, go roll your hoop.

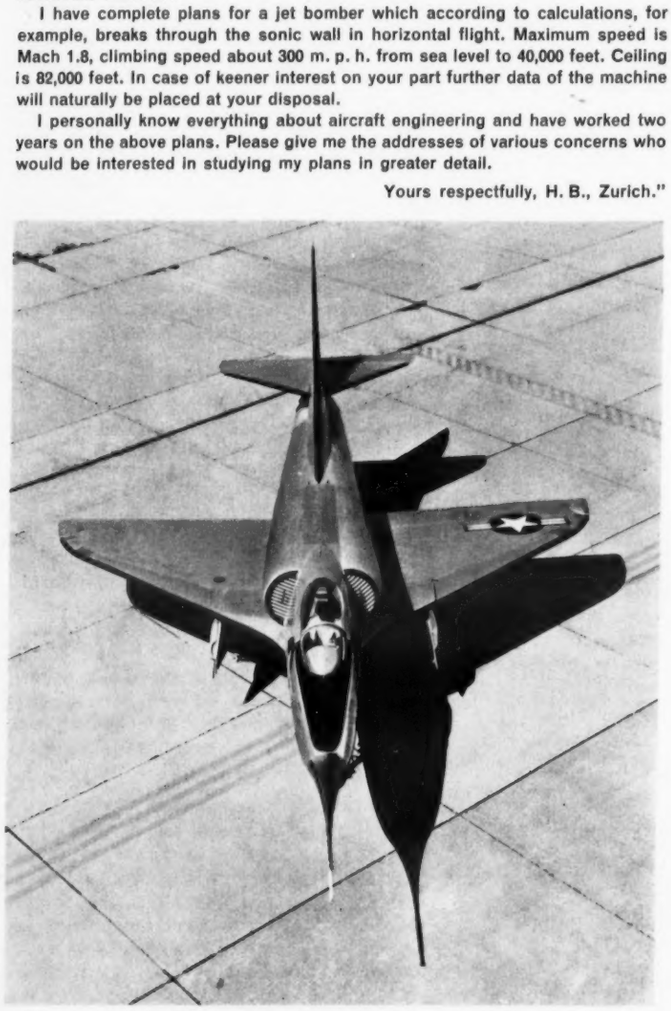
You're nuts, Esmeralda replies, turning to the door, you're making N.A.T.O. lose the next war which will not take place anyway because everybody is so well armed with A-bombs. Earlier wars have broken out only because nobody has ever had any arms to fight them with.

Don't go yet, we say in desperation, apropos letters. Thank you for that absent-minded missive you sent us from England recently, addressed to *Interavia, Italy,* period. It reached us promptly at its proper destination, *Geneva, Switzerland,* but you might think a little more about those harassed post office officials and a little less about that co-pilot or whatever he is.

That, smiles Esmeralda, is the curse of being famous. If you weren't famous, you wouldn't have had to read my twaddle.



How Esmeralda writes to "Interavia" ...



A4D-1 SKYHAWK

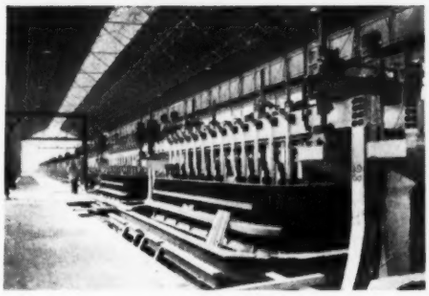
Douglas' light carrier-based A-bomber

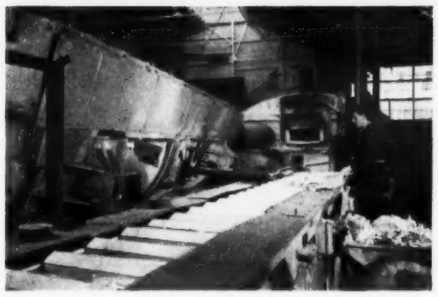
The Douglas A4D-1 *Skyhawk* fills a gap in the present gallery of carrier-based fighter-bombers for a light handy "pocket edition". Its designer, Chief Engineer Edward H. Heinemann, set out to give it all the equipment which a modern carrier-based fighter-bomber needs, without an ounce of "dead weight".

The *Skyhawk's* characteristics follow logically from this principle:
Delta wing only 25 ft. in span (not folding);
fuselage length 39 ft;
weight empty approx. 8,300 lbs.

Power plant is a Wright J-65 turbojet of 7,200 lbs. take-off static thrust. No performance figures are available, though it has been announced unofficially that range and military load are roughly equal to those of a World War II medium bomber (range approx. 650 miles; useful load probably one to 1½ tons). According to American press reports, max. speed is in the region of 650 m.p.h.

Aluminium Celebrates its Centenary





Multi-anode 100,000 Amp. electrolytic baths (left) and continuous pouring of aluminium blocks (right) at Société Péchiney's Saint-Jean-de-Maurienne plant.

BY JEAN GUILLEMIN, PARIS

Well known for his work before the war at Hanriot on a whole series of trainers, at Bacalan where he made the first firing test with a 75-mm cannon in a large aircraft and then as a member of the team of Blériot who made his prototypes, Engineer Jean Guillemin *today works for* Aluminium Français, Société Générale du Magnésium, *the Board of* Société Péchiney *and of* Société d'Electrométallurgie d'Ugine.
The following article briefly relates the origin of aluminium, some of the progress made in its use and the value of the latest alloys in the production of airframes and jet engines.

The past century has seen a metal, barely isolated from its natural state, progress from the laboratory to the semi-industrial and finally to the industrial stage in which it is now distributed throughout the world at the rate of 2,500,000 tons a year.

The same century has seen the birth of a powerful industry to work it up, giving birth in turn to hundreds of others, among which the aviation industry incontestably has earned the highest engineering honours.

This is a centenary that should not be allowed to pass unnoticed. It is of interest to both engineers and the general public and amply justifies the International Congress and Exhibition which the *Société Chimique de France* and *Aluminium Français* have organized in June and July this year to commemorate the past and spotlight the progress made up to the present day.[1]

A bit of history

In 1827 when many chemists were still pursuing in vain their dream of proving the existence of " ammonium ", others, more alert, such as *Friedrich Wöhler* in Germany, *Sir Humphry Davy* in England *and Christian Örsted* in Denmark, shared the merit of isolating aluminium. Using chlorine, they separated aluminium from its potassium compounds and obtained the first samples of a new metal. These samples contained many impurities which gave them a granular appearance, but the new material had such a low specific density that it was immediately hailed as a great discovery. Needless to say, it gave new impetus to scientists of the day, who tried all means of obtaining a few ingots of the precious metal, but none of them got beyond the experimental stage.

It was left to a Frenchman, *Henri Sainte-Claire Deville,* to perfect in 1854, the very first industrial production process for aluminium. The young doctor and scientist, who combined the qualities of the theoretical and practical engineer, was 36 years old at the period and had just been appointed *Maître de Conférences* at the *Ecole Normale Supérieure.*

Having succeeded in producing sodium on an industrial basis, he substituted it for potassium, at that time very rare, and made his first experiments at Javel in 1855. They were immediately conclusive. The grey powder, full of impurities, straight away became a shining metal with interesting mechanical characteristics.

Several factories were opened one after the other: Rouen, La Glacière, Nanterre, finally at Salindres (in Le Gard) near bauxite mines, which in 1860 were already producing 1,100 lbs. of aluminium a year.

An amusing fact is that, being so rare, the first aluminium ingots were eagerly sought after by silversmiths and sculptors who treated the metal as a lighter form of silver and made of it works of art, some of which still exist today in a perfect state of conservation.

In France production continued steadily, but the few plants set up elsewhere worked only spasmodically until the possibility of using electricity, and especially hydro-electric power, enabled the chemical method of production to be replaced gradually by the electrolytic method. Sainte-Claire Deville had foreseen this development, which he had described in a report to the French Academy of Science.

In 1886 two men working entirely independently 3,000 miles apart—*Paul Héroult* in France and *Charles Martin Hall* in the United States—each filed practically identical patents for a new electrolytic process for producing aluminium. Starting with aluminium oxide, which could already be obtained from bauxite, they electrolyzed this oxide from solution in fused cryolite.

Cryolite, sodium aluminium fluoride, is used merely as a solvent to reduce the melting point of the mixture. Electrolytic decomposition takes place at around 1,000° C and requires a powerful low-voltage current. The liquid aluminium settles in a sheet on the cathode at the bottom of the vat, and the oxygen passes to the anode, consuming it and liberating carbon monoxide and carbon dioxide. Anode and cathode are of carbon.

The chemical process invented by Sainte-Claire Deville was practically the only one used, with variants, up to 1888, and France was by far the leading producer, thanks to the Salindres factory, whose annual output had risen to 3 tons.

[1] From June 12th to July 31st, on the banks of the Seine in Paris, between the Invalides and Alma Bridges.

Friedrich Wöhler (1800-1882)

Sir Humphry Davy (1778-1829)

Hans Christian Örsted (1777-1851)

Henri Sainte-Claire Deville (1818-1881)

Paul Héroult (1863-1914)

Charles Martin Hall

The effect of Héroult's invention resulted in a complete breakaway from former methods. The change, however, did not take place immediately. Although the value of the new process was obvious, industrialists of the day were doubtful about market possibilities. Demand for the Salindres output was not great, and M. Alfred Rangod, nick-named " Péchiney ", then managing director of the firm, was consequently more concerned with marketing problems than with production methods. His first meeting with Héroult, whom he did his best to convince of the potentialities of the then popular aluminium bronze, is eloquent proof.

Nevertheless the electrolytic process was a great step forward, since it enabled the cost of the metal to be reduced by nine tenths and thus vastly improved sales. Before the war only 2 kg. of aluminium oxide, 7 kg. of carbon and 22 kWh of electricity were needed to produce 1 kg. of pure aluminium.

This, however, is not the end, and atomic power stations, such as were inconceivable a few years ago, will doubtless have a beneficial effect in the near future on both production and cost.

From the first plant to modern production and working methods

All aluminium throughout the world today is produced by electrolysis, but there has been a long road from the earliest installations to those of today.

Although French industry no longer holds first place in output tonnage, as the figures below show, it is still in the forefront of technical progress, both in production and in working up, since it has some of the world's most advanced and economical installations.

World output of aluminium in 1953
(in metric tons)

United States	Canada	U.S.S.R. and satellites	France	Germany	Norway
1,135,600	495,000	370,000	112,200	106,000	55,600
Italy	**Japan**	**United Kingdom**	**Switzerland**	**South America**	**All other countries**
55,300	45,600	31,400	29,000	2,000	66,900

At Neuhausen (near Schaffhausen, Switzerland), and later at Froges (Isère, France), Héroult used cylindrical vats fed by a current of several hundred ampères. This was rapidly increased to 5,000 Amps, and before the last war electrolytic vats were more or less standardized at 20,000, 30,000, 40,000, 50,000 and even 60,000 Amps, with a voltage of about 5V.

Constantly increasing demand since the war has led *Société Péchiney* to reorganize its factory equipment. The necessity was to produce more and at lower cost. Theoretically there were several ways of achieving a reduction in cost :

— by reducing the cost of electricity and of the carbon required for the electrodes (not likely to happen since nationalization) ;

— by reducing the amount of electricity consumed for a given weight of metal ;

— by reducing the manpower needed to operate the vats (for recharging the anodes, loading the vats, breaking up crust of alumina and cryolite on the surface of the bath, to enable it to melt again) ;

— by simplifying the pouring process.

After lengthy and detailed research, the company perfected a new type of vat for 100,000 Amps. in 1949, of which 116 are now in operation. Special features of the new equipment include not only the composition of the cathodes but also the various mechanical devices which greatly facilitate the operation and adjustment of each unit. The anodes are of the Söderberg type, with vertical current feed (process perfected in France). Higher production capacity per unit has helped to reduce investment and depreciation costs, both of the furnaces themselves and of the buildings housing them.

Whereas in 1938 a ton of metal took nearly 52 man-hours to produce, and even recently this figure varied between 12 and 16 man-hours for the latest American furnaces, the Saint-Jean-de-Maurienne plant does not exceed an average of 8 man-hours per ton. At the same time electricity consumption has fallen from 22,000 kWh to less than 17,000 kWh per ton.

This puts France well ahead of the rest of the world in this field. A contract has just been signed between *Société Péchiney* and Anaconda in the United States for the construction of a plant of 240 furnaces, and a similar contract with the Aluminum Company of America (Alcoa), the biggest aluminium firm on that side of the Atlantic. More recently still engineers from Aluminium Ltd. of Canada (Alcan) have been to Saint-Jean-de-Maurienne to see how this one plant alone turns out 25,000 tons of aluminium a year.

*

The industry working up the raw metal into sheets, tubes, bars and extrusions of all kinds has kept pace, or even surpassed, the basic production industry.

An important advance was made in 1937 with the introduction of continuous pouring. This process uses annular containers 2 to 8 inches high closed at the bottom by a piston and cooled by large quantities of water. The billets obtained by this method, later adopted in Germany, Switzerland and the United States, have much improved homogeneity.

However, the most striking progress has been made through the installation of continuous rolling plant derived from designs of *Société Centrale des Alliages Légers*, of Issoire. This factory, although begun before the war, did not start operating until 1950, but its equipment, removed in 1940 to prevent its falling into German hands, served as a model for the Americans' new installations, which are built on exactly the same principles. A similar rolling mill has recently been set up in Britain.

Continuous rolling of light alloys is not a simple extension of the methods used for steel, since the materials dealt with are quite different.

The Issoire installation comprises six rolling plants on a common axis and interconnected by continuous belts with shears for cutting lengthwise and crosswise. The whole is supervised by one man with five or six assistants. Total length of the installation is 740 ft.

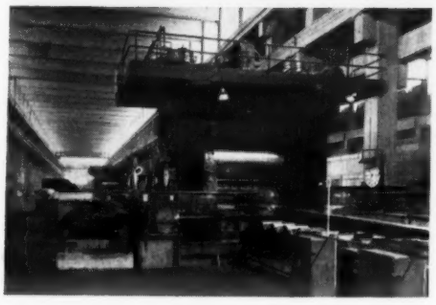
The first machine is a hot rolling four-high reversing mill (two small work rolls and two large support rolls) 9.3 ft. wide, followed by three hot rolling four-high and two cold rolling four-high mills, all of the same width. The installation is completed by a four-high mill 8.2 ft. wide for cold rolling of sheets more than 1/8 inch thick in semi-hard or cold-hardened qualities.

Sheets of variable gauge, with single or double taper, are made on special mills with automatic regulation of the distance between the rolls.

Foreign mills (seven in the United States, one in Britain, probably none in Central or Eastern Europe) are generally heavier than that at *Société Centrale des Alliages Légers*. Yet the latter is one of the widest. The only mill exceeding 10 ft. in width is ALCOA's at Davenport. With such installations it was possible to obtain output rates and sheet dimensions (33×7.5 or even 8.2 ft.) such as were unknown some time ago and which fully meet the need of the aircraft industry for wing and fuselage skins.

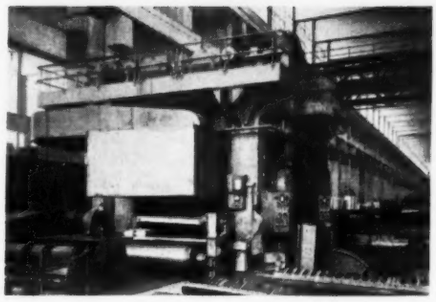
Aluminium and the aircraft industry

Although aluminium is in general use in aircraft production, this industry absorbs only a small percentage of world output. Use in the automobile, building, electricity, railway, packing and household utensils industries, to name but a few, has grown to a frequently unsuspected extent, as is indicated in the following rough table :



At the beginning of the rolling line at Issoire (Société Centrale des Alliages Légers) a hot rolling reversible four-high mill...

... is followed by three more hot rolling four-high mills of the same width (9.3 ft.).



At the end of the line there are two cold rolling four-high mills 9.3 ft. wide.

Some of the applications of aluminium and percentage used

	Automobiles and road transport	Building	Electrical industry	Railways	Packing	Household utensils	Aviation
United States	16.5	14	10	2	7	14	* 14
France	26.14	3.85	15.63	1.16	10.22	12.1	4.03
Britain	22.6	10.2	4.48	0.41	11.4	9.7	* 7.78

* estimated

Special alloys today available include

— up to 230°C	A-U2GN.	Composition : 1.05 Fe ; 0.25 Si ; 2.25 Cu ; 1.15 Ni ; 1.55 Mg ; 0.07 Ti.
— up to 250°C	A-U2GNZr.	Composition : 1.05 Fe ; 0.25 Si ; 2.25 Cu ; 1.15 Ni ; 1.55 Mg ; 0.07 Ti ; 0.08 to 0.2 Zr.
— up to 300°C	A9-U2GNZr.	Composition: roughly the same as the above but based on refined aluminium.

Nevertheless, despite the relatively small quantities it uses, the aircraft industry has always been at the head of technological progress in aluminium working, and its casting, forging, rolling, stamping, welding and bonding processes have been the basis for many of the new applications.

Even in the early days the appearance of rolled and drawn semi-finished products spurred inventors on to a number of daring projects. The oldest of these is doubtless that of Félix du Temple who began building a flying machine in 1857 whose wings had a tubular longeron of decreasing section, 50 ft. long and made by rolling and riveting thin sheet. He was rapidly copied, and there is no end to the flying machines and particularly dirigibles with metal envelopes that were designed or built with varying success during the next fifty years.

As the mechanical characteristics of pure aluminium are relatively low, alloys are made to combine the advantages of light weight with much greater strength.

It was Alfred Wilm, working for the *Dürener Metallwerke* in Germany, who discovered by chance about 1906 the effect of quenching in cold water and aging on aluminium-copper alloys. He christened his alloy " duralumin " from the name of his firm at Düren.

Thus was the ideal aircraft metal born. Vickers Ltd., of Great Britain, followed by *Société du Duralumin* in France, started production of it in 1910. Its initial uses, however, were for cartridge cases, bicycle wheel rims and even corset bones.

World War I, which began with wood and fabric aircraft, first saw the application of duralumin in aircraft construction. The pioneers were undoubtedly Louis Bréguet with his famous Bréguet 14 and Junkers with the J.4, not to mention Count Zeppelin's rigid airships.

Needless to say, today's aluminium alloys are far superior to Wilm's duralumin. Efforts during recent years have been concentrated on obtaining alloys with good characteristics at high temperature for compressor rotors in jet engines and others with good forging and rolling qualities for airframe construction.

The appearance of sintered aluminium, the result largely of Swiss experiments, finally opens up entirely new possibilities for parts subjected to great heat.

*

It is important that alloys used for compressor rotors, which are subject to very heavy vibrations and centrifugal forces, should retain sufficiently good mechanical properties at high temperature to prevent them from breaking or even deforming beyond the narrow tolerance limits permissible in operation. The dangers here are fatigue and creep.

As such high temperatures have not yet been reached in normal operation, increases in the power of jet engines based on higher compression ratios and higher working temperatures will not be hampered for some time to come by any lack of suitable light alloys.

For airframe construction, normal duralumin (A-U4G) was long the basic metal used. Then rapid improvements led to the high-strength duralumin (A-U4G1) now in universal use. Other special alloys suitable for airframe construction include :

— **A-U4Sg.** Composition : 0.5 Fe ; 0.9 Si ; 4.2 Cu ; 0.45 Mg ; 0.8 Mn.
— **A-Z5GU.** Composition : 0.45 Fe ; 0.25 Si ; 0.4 Cu ; 2.7 Mg ; 0.55 Mn ; 5.5 Zn.
— **A-Z8GU.** Composition : 0.25 Fe ; 0.2 Si ; 1.6 Cu ; 2.65 Mg ; 0.22 Cr ; 8 Zn.

The last-mentioned, A-Z8GU, known as Zicral, has the highest characteristics. It was perfected in France several years before being produced elsewhere and is still used only in small quantities. Compared with normal duralumin its minimum properties are as follows :

Normal duralumin	Tensile strength	Yield strength	Expansion	Zicral	Tensile strength	Yield strength	Expansion
	p.s.i.	p.s.i.	%		p.s.i.	p.s.i.	%
rolled :	56,800	35,600	16	rolled :	73,900	62,500	8
drawn :	59,700	39,800	12	drawn :	85,300	78,200	5

Sintered aluminium is " baked " from powder previously compressed to the desired shape. The process is similar to that employed in ceramics, in which the powder is bonded together at a temperature not sufficiently high to fuse it. Whereas normal aluminium and alloys rapidly lose their strength above a temperature of 220°C, sintered products are greatly superior in this respect, though their initial strength at low temperatures is less.

*

Will aluminium and its alloys continue to hold a virtual monopoly in aircraft manufacture ? This is not altogether certain, though it may be assumed that they will persist in some form, in combination with other materials. Advanced planners are already beating the drum for pressed and laminated plastics. Without going so far, it is clear that the new ultra-light magnesium-zircon alloys and those based on titanium, a semi-light metal industrial production of which is now getting under way, have a most promising future.

From the Conference Room

A.G.A.R.D., A.I.C.M.A. AND I.C.A.O. EUROPEAN CONFERENCE

Chairman's table at the A.I.C.M.A. General Meeting: (left to right) *M. Guilbot*, head of the French Aircraft Manufacturers Association; *E. Fraccon*, head of the Italian Aircraft Industries Association; A.I.C.M.A. Chairman *General A. Bruno*, Chairman of the Italian A.I.A.; *Prof. G. Gabrielli*, Managing Director of Fiat.

The calendar of international conferences seems to indicate that mankind is particularly ready to get together in the fifth month of the year. At any rate the aviation chroniclers record meetings in May 1954 of three organizations which serve some of the most important branches of aviation: research, industry and air transport.

Fourth General Meeting of the Advisory Group for Aeronautical Research and Development, Scheveningen, Holland, May 3rd to 7th, 1954.

The Advisory Group for Aeronautical Research and Development was set up early in 1952 by the North Atlantic Council, for the following purposes: to coordinate aeronautical research in the N.A.T.O. countries, to collate scientific literature and the work of research institutes, to encourage professional contacts between aeronautical scientists, to advise N.A.T.O. on all aviation questions (cf. *Interavia* No. 8, 1952 " From Newton's Notebook to Mammoth Research Organizations ").

The Fourth General Meeting, presided over by Professor Theodore von Karman, once again provided striking evidence of how closely A.G.A.R.D. cooperates with practical aviation. The central theme of the gathering was " Human Factors in Aircraft Design " (the main paper was read by Dr. Morley G. Whillans, Canada). The discussion was attended by such internationally famous test pilots as Commandant Carpentier (France), Squadron Leaders Duke and Potocki (Britain), Scott Crossfield and Major Yeager (United States).

The activities of A.G.A.R.D.'s specialist committees are briefly outlined below: *Documentation Committee:* international aeronautical dictionary (first edition scheduled for spring 1955). *Wind Tunnel and Model Testing Panel*: theme, high-speed wind tunnels. *Flight Test Panel*: flight test methods in use in various N.A.T.O. countries (servo-mechanisms, vibrations and noise in flight, oscillographic recordings, etc.). Recommendations: creation of a sub-panel on rotary-wing aircraft; study group on airworthiness requirements. *Aviation Medicine Panel*: human engineering, or adapting the aircraft to the pilot. *Combustion Panel*: papers on heterogeneous flames and aspects of carbon formation.

Professor von Karman was re-elected Chairman of A.G.A.R.D.

General Meeting of the International Association of Aircraft Manufacturers (Association Internationale de Constructeurs de Matériel Aéronautique), Madrid, May 13th.

Formed in April 1950 as a permanent link between the European aircraft industries (member countries: Belgium, Denmark, France, Italy, the Netherlands, Norway, Spain, Switzerland), A.I.C.M.A. has the following tasks: common examination of all questions concerning the future of the aircraft industry, planning and suggestion of guiding principles for the member industries, representing the European aircraft industry in all cases where joint action is required (cf. *Interavia* No. 10, 1953 " A.I.C.M.A.").

The Madrid meeting saw the first example of practical cooperation on a European scale. It was decided that the installations at the *Nationaal Luchtvaart Laboratorium* (National Aviation Laboratory) now being built near Amsterdam should be operated on a cooperative basis. A technical committee was appointed to supervise construction.

A.I.C.M.A.'s new committee comprises: Chairman: *General A. Bruno*, Chairman of the Italian Aircraft Industries Association (Associazione Imprese Aeronautiche); Vice-Chairman: *P.A. van de Velde*, President of the Dutch firm of Aviolanda; Treasurer: *P. Huarte-Mendicoa*, Chairman of the Spanish Aircraft Industries Association (Agrupación Española de Constructores de Material Aeronáutico); Secretary-General: *André Granet*, Secretary-General of the French Aircraft Manufacturers Association (Union Syndicale des Industries Aéronautiques).

In recognition of his services in the creation of A.I.C.M.A., retiring Chairman Georges Héreil, Managing Director of S.N.C.A. du Sud-Est, was named " Founder-President of A.I.C.M.A." (with the right of vote at all meetings of the committee). The same title was conferred posthumously on P.J.C. Vos, late Managing Director of the Fokker Works.

Theory and practice in fruitful collaboration: A.G.A.R.D. Chairman (third from right) with internationally known tests pilots on the terrace of Scheveningen Kurhaus: (left to right) W. J. Potocki and Squadron Leader Neville Duke (Britain), Scott Crossfield (U.S.A.), Professor von Karman, Major Charles Yeager (U.S.A.), Commandant Roger Carpentier (France).

International Civil Aviation Organization Conference on the Coordination of European Air Transport: Strasbourg, April 21st to May 8th.

Convened at the suggestion of the Council of Europe (Strasbourg), this regional conference organized by the International Civil Aviation Organization, was attended by representatives from Belgium, Denmark, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and Western Germany.

Two main subjects figured on the programme:

a) Methods of improving economic and technical cooperation between the airlines of the countries concerned.

b) Closer cooperation between European countries through the more liberal grant of traffic rights.

Despite the sympathy with which this conference was welcomed in air transport circles, it cannot in truth be denied that its results were meagre : platonic recommendations to governments (... whose delegates had actually gone to Strasbourg to make practical decisions) and agreement in principle to the creation of a permanent regional organization for European air transport (European Civil Aviation Conference), to be composed of the aviation authorities concerned and to have the task of finding solutions to specific problems in European air transport ... *basically this was the sole outcome.*

The following is a brief outline of the subjects discussed :

Multilateral air transport agreement

The Conference came to the conclusion that the time was not ripe for a multilateral agreement on the coordination and liberalization of European air transport. A certain amount of preliminary work was done, however, and basic agreement reached on a number of points.

Cooperation

Recommendation to aviation authorities to encourage the conclusion of route agreements between airlines ; improvements in methods of flight plan preparation ; standardization of air-to-ground radio communications by the exclusive use of R/T ; facilitation of the exchange of aircraft (with or without crews) between airlines.

Liberalization

Recommendations of traffic facilitations (visas, customs formalities, aircraft documents etc.) ; shortening of ground waiting times ; grant of greater freedom (commercial landing rights) for non-scheduled airlines (provided scheduled airlines do not suffer) ; liberalization of freight transport by elimination of rules on capacity limitation and greater liberality in freight route planning.

Guarantees against uneconomic competition

Proposal that the above-mentioned European Civil Aviation Conference be set up and recommendation to the I.C.A.O. Council to prepare a multilateral agreement for the European nations.

Khartoum, Cross-Roads of Africa

BY E. E. WARBURG, LONDON

A Sudanese Controller seated at the Air Traffic Control Desk—developed by International Aeradio — which forms part of the equipment of the new Khartoum Airport.

Progress is a relative term. Where the invention of the wheel was a major progressive step in the history of the ancient Egyptians, and the use first made by the Chinese of the printed character was to have literally unforseeable effects, such apparently simple yet revolutionary inventions do not appear to emerge in our world of to-day.

Yet, the opening of *Khartoum Airport* can be recorded as a major step along the road of development, as far as Africa is concerned, and typical of what we consider as " progress " to-day.

Khartoum, capital of the Anglo-Egyptian Sudan, is an important aerial cross-roads on Africa's aviation map. Handling as it does a thousand aircraft movements a month and 150,000 passengers a year, it was only right that Khartoum should acquire a modern airport. The new facility was developed from one existing at the end of World War II. The North-South runway was extended to 2,134 metres and strengthened to take a single-wheel loading of 20,000 kilograms ; a large parking apron was prepared ; a very fine terminal building was erected—this one is probably unique as it is built in the shape of an aeroplane. The technical services, the telecommunications, air traffic control, airfield lighting and safety services, were installed according to a carefully prepared plan.

As His Excellency the Governor-General of the Sudan, Sir Robert Howe, said in the speech with which he officially opened the Airport on 15th April, 1954 :

> *" Our... thanks are due to the British Ministry of Transport and Civil Aviation. They have not only subscribed about £400,000 or rather more than half the cost of the airport, but have also interested themselves in every stage of the project... Many others have contributed in various ways... the Department of the Director General of Works in the Air Ministry in London ; the Public Works Department, Khartoum... ; International Aeradio Limited who have installed and operate the communications and navigational aids... "*

Of the above contribution surely the financial subscription of the British Government should receive special attention. To contribute £400,000 of the total cost of £765,000 and thus to endow Khartoum with a capital investment which is liable to bring in a revenue of over £100,000 per annum, is a mark of the importance to British aviation which the government attributes to Khartoum and also one of generosity when viewed in the light of the unsettled political background of the Sudan to-day.

The official opening of the airport was attended by a colourful mixture of races and creeds, which included European government servants and businessmen, European and Sudanese service officers, members of the newly elected Sudanese parliament, some in European dress, but the majority with their dark bearded faces set off by their turbans and galabiahs, the traditional long, white flowing robes of their forefathers. In the forefront, in the company of the senior British officer in the Sudan, was the grandson of the Mahdi, the man whose followers seventy years ago had been the cause of Kitchener's campaigns in their attempt to drive British and Egyptians from their land.

After delivering his opening speech the Governor-General toured the terminal building, passenger accommodation, customs, restaurant and up-to-date kitchens. He inspected the telecommunications and air traffic control centres, the design and installation of which had been entrusted to International Aeradio Limited, London. Much of the equipment, such as the ATC desks in the Flight Information Centre and the tower, had been specially designed for this airport. The technical equipment includes VHF and HF transmitters and receivers, automatic VHF D/F, radio beacons, and storm warning radar. High frequency radio telephony also exists, enabling pilots of aircraft operating anywhere in the Sudan to speak directly to the controller in the Flight Information Centre at Khartoum. The provision of this facility has already enabled at least one airline operating into Khartoum to dispense with its radio operators. International Aeradio is responsible for the daily operation and maintenance of these facilities and employs nearly 100 Sudanese technical and administrative staff, many of whom have been trained by the company.

The inauguration of the airport was rounded off by a flypast and air display by the airline users of the airport and by military aircraft. *Vampires* of 205 Squadron, R.A.F., had flown down from the Canal Zone especially for the ceremony. Their demonstration consisted of a perfect exhibition of close formation flying and aerobatics, ending in a realistic " fireworks display ". To do this they came flying down the runway and when opposite the tower they swept vertically upwards for several hundreds of feet before peeling off in all four directions to the accompaniment of a whine and explosion which turned out to be a fifth *Vampire* just starting up on the ground.

In the fast setting sun the jets came in to land. The Governor-General departed, the guests started to move silently away—perhaps pondering on what they had seen. Here was progress indeed visiting them in the heart of Africa. But could this step be compared in any way with the wheel which came out of Africa many centuries ago ? Was there a comparison to be drawn of the far-reaching effects of each ? Indeed, progress *is* a relative term.

First Mystère IV delivered to N.A.T.O.: The U.S. Air Force took over Marcel Dassault's first MD 452 *Mystère IV A* at Bordeaux-Mérignac airfield. The fighter is to be supplied to the French Air Force under American arms aid.

What's in the Air ? *

AVIATION POLITICS

• Towards the resumption of Franco-Russian air transport

Following up the March visit of Aeroflot President *Marshal Zhavoronkov* to Paris, a *French air transport delegation has gone to Moscow* to continue talks on the resumption of air services between France and Russia. The delegation is led by M. Moroni, Director of Air Transport at the Secretariat of State for Civil Aviation, and includes *Max Hymans*, President and Managing Director of Air France, M. *Chantereau* (Foreign Relations Department of Air France), *M. Lescure* (Secretariat General for Civil and Commercial Aviation), *M. Fronheim* (Air France Manager for Germany).

• Anglo-American guided missile cooperation

A joint communiqué has been issued on the Washington talks between *British Minister of Supply Duncan Sandys* and *U.S. Defense Secretary Charles E. Wilson* stating that talks covered a number of matters of "mutual interest in connection with the development and production of weapons". Particular attention was paid to problems relating to the development of guided missiles with the object of securing "more active cooperation in this field."

SERVICE AVIATION

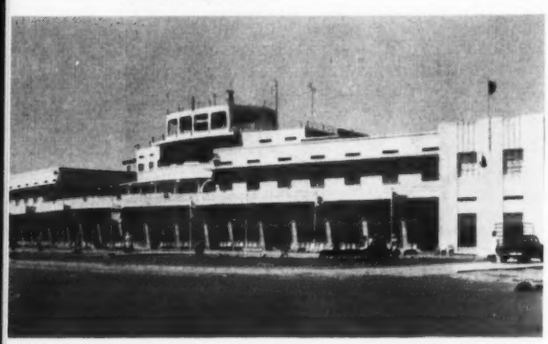
• Regulus for Nautilus

The American atom-powered submarine *Nautilus* is to carry Chance Vought *Regulus* guided missiles. The *Regulus* is 32 ft. long and spans 20 ft., with folding wing tips for easy stowage, and weighs 14,552 lbs. Power plant: Allison turbojet and take-off rockets.

• More Canadair Sabres for Turkey and Greece

The Standing Group of the North Atlantic Treaty Organization has recommended the transfer of an additional 110 Canadair-built North American F-86 *Sabres* to Turkey and Greece, according to a statement by Canadian Defence Minister Brooke Claxton. The aircraft, to be made available under Canada's Mutual Aid Program, are in addition to the 54 *Sabres* to be delivered this summer and autumn.

The new terminal building at Khartoum Airport which was inaugurated on April 15th.



• "Piktufif" base

The U.S. Air Force's well-known Greenland base of Thule is to be renamed. Choice is between "Dundas" and "Piktufif".—In the Eskimo tongue Piktufif means "a place where you tie your dogs when resting."

• High N.A.T.O. post for Canadian air officer

Group Captain I.C. Cornblat of the Royal Canadian Air Force has been appointed Assistant Chief of Staff for Administration at Headquarters, Allied Forces Central Europe, Fontainebleau and promoted to Air Commodore. He will be responsible for effecting greater amalgamation of organizational branches within the air, land and naval commands of Central Europe.

AIR TRANSPORTATION

• Capital Airlines orders Viscounts

Considerable interest has been aroused by the fact that Capital Airlines, a medium-sized American airline with network on the East Coast and the Middle West of the United States, has ordered *three* Vickers *Viscounts* and taken an option on 37 more. The order is said to have come as a surprise even to Vickers, who had not expected orders from the United States until later, when the 15 *Viscounts* bought by Trans-Canada Airlines have gone into service on the Montreal-New York route.—Vickers and Rolls-Royce (makers of the *Dart* propeller turbines used in the *Viscount*) are negotiating for maintenance facilities in the United States and on the question of spares.—The U.S. Civil Aeronautics Administration's decision on a certificate of airworthiness for the *Viscount*, on which everything else depends, has not yet been made public.

• REAL becomes major international airline

The Brazilian airline Real Transportes Aereos S.A. appears to be setting out systematically to buy up Brazilian air transport. On May 25th its merger with Aerovias do Brasil, which had been in serious financial difficulties, was announced. Although Real now owns 87 % of Aerovias capital, the name Aerovias has become part of the new firm's name —Real-Aerovias— so that the foreign traffic rights granted the latter company can be retained.—Merger talks are also in progress with Viaçao Aereo de Sao Paulo, and the next airline on the list seems to be Nacional Transportes Aereos Ltda.—The merger with Aerovias has already made Real into one of the most important airlines in Latin America (73 aircraft). There is believed to be American capital behind Real's expansion programme.

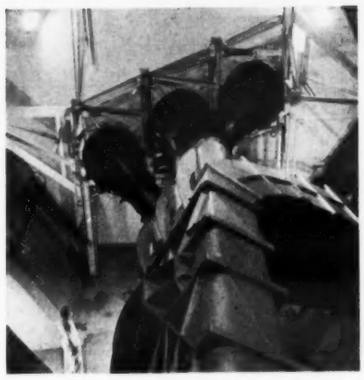
• Japan Air Lines in financial difficulties

The semi-Government-owned Japanese flag carrier Japan Air Lines, which opened its first foreign route four months ago, is facing a serious financial crisis, which may even necessitate the suspension of international services. A decision to double the capital of 2,000,000 yen by issuing new shares is regarded sceptically by the Japanese Finance Ministry, since an annual deficit of 1,000,000,000 yen is expected. J.A.L.'s 500 yen shares are at present offered on the stock exchange at 200 yen. The Japanese Government states that further subsidy (1,000,000,000) will only be granted if services are reorganized or limited until financial equilibrium is restored.

S.N.C.A. du Sud-Ouest has had a medal struck and awarded to 28 persons who have flown at supersonic speeds in the Vautour jet aircraft. They include *Louis Christiaens*, French Secretary of State for Air, *Colonel Manson* (U.S. Air Force), *Commandant Roger Carpentier*, Chief Pilot at Brétigny Flight Test Centre, *Jean Girard* and *Jacques Guignard* of S.N.C.A. du Sud-Ouest.

The first *Agusta-Bell 47 helicopter* built under licence by the Italian firm of G. Agusta has been test flown in Milan. The flight was watched by (left to right): Colonel C. Borre (U.S. Air Force), O. Loucia (member of Italian acceptance commission), Lawrence D. Bell, D. Smith (Bell Aircraft Corp.), Mario Agusta, Engineer Dema (colleague of Zappata's), Engineer Filippo Zappata.

* Extracts from *Interavia Air Letter*, daily international news letter, in English, French and German. All rights reserved.



De Havilland's new wind tunnel for flow speeds of Mach 0.8 to 1.6. Pictures show the control desk, the three D. H. *Ghost* engines whose exhaust enters the tunnel behind the test section.

INDUSTRY

• United—Chance Vought split

The separation of Chance Vought from United Aircraft Corp., planned for the past year, is definitely to take place in July 1954, now that United's Board of Directors has approved distribution of Chance Vought stock to holders of United Aircraft common stock. Chance Vought has been operating as a wholly-owned subsidiary since January 1st, 1954.

• U.S. Air Force orders for Convair and McDonnell

A synopsis of contract awards recently published by the U.S. Department of Commerce reveals that the U.S. Air Force has signed new contracts with Consolidated Vultee Aircraft Corp. and McDonnell Aircraft Corp. calling for almost $109,000,000 worth of jet fighter, fighter-reconnaissance and trainer aircraft. Convair gets an order for $74,942,059 for 37 F-102 fighters and 20 TF-102 trainers; McDonnell for $34,025,262 for 28 RF-101 *Voodoo* trainers.

• DVL rising again

During the period end of 1952 to June 15th, 1954 a total of 850,000 Marks was provided from public funds for the re-activation of the German Aeronautical Research Institute (Deutsche Versuchsanstalt für Luftfahrt). Of this sum the Province of North-Rhine Westphalia has subscribed 800,000 and Bavaria 50,000 Marks. Up to the end of 1953 roughly 190,000 Marks had been spent on research equipment. Staff numbered 43 on March 31st, 1954, of which 36 were working at the DVL Institutes in Aachen, Mühlheim and Bonn.

Professor Dr. Quick, who worked for some time in France on the development of ramjet engines after the end of the war, takes over a leading post with the DVL on July 1st.

• Fourth International Engineering Show, Turin

The Fourth International Engineering Show will be held in Turin's exhibition premises from September 29th to October 10th, 1954. The aviation section will show airframe parts, jet engines, piston engines, accessories, aircraft instruments, ground installations etc. The list of exhibitors already includes a large number of Italian and foreign firms, e.g., Fiat S.A., Officine di Pomigliano d'Arco, Officine Viberti, Ottico Meccanica Italiani & Rilevamenti Aerofotogrammetrici, Filotecnica-Salmoiraghi, Siemens Italiana, Etablissements Science Technique, Oleodinamica Magnaghi, Microfusione Italiana, Secondo Mona.—The Sixth International Plastics Congress will be held during the Show.

• Syrian order for I.A.L. and Marconi

The Syrian Ministry of Defence has placed an order with the British firms of International Aeradio Ltd. and Marconi's Wireless Telegraph Co. Ltd. for radio and radar equipment and the joint planning and erection of a complete radio network including automatic and manned VHF stations (mobile and fixed). The two companies are also to organize a technical training centre for Syrian Air Force personnel.

FLYING EQUIPMENT

• After lengthy negotiations, the U.S. Air Force has decided to include the Convair XB-58 *Hustler* supersonic bomber in its construction programme. It is estimated that development, prototype construction and quantity production will cost roughly $100,000,000 a year. However, final production will probably cost many times this amount.—The *Hustler* is a four-jet delta-wing model, with engines (General Electric J-79 or Pratt & Whitney J-75; thrust class 15,000 lbs) suspended in pods underneath the wings.

• The Chance Vought F7U-3 *Cutlass* can carry an undisclosed number of 2.75-inch *Mighty Mouse* rocket projectiles in a light metal container beneath the fuselage, in addition to its 20-mm cannon. The container cannot be jettisoned in flight, but can be rapidly reloaded as soon as all rockets have been fired. For certain missions the *Cutlass* is flown without rocket container.—Two more containers with 19 *Mighty Mouse* rockets can be carried under each wing. They are made of plasticized card-board and are dropped after use.

Test section of the new de Havilland wind tunnel; throat measures 2 ft. square

• Flight testing of the *Fiat G.82* turbojet fighter trainer has begun at Turin-Caselle airfield. It differs from earlier versions of the G.80 in its power plant (Rolls-Royce *Nene* instead of de Havilland *Goblin*) and in some of its equipment (cf. picture in the list of N.A.T.O. aircraft elsewhere in the issue).

• The first *Fouga CM.170-R Magister* has been completed at S.N.C.A. du Sud-Est's La Courneuve plant. It is the first aircraft of a pre-production batch of ten, and will shortly be taken to Toulouse for flight testing.

• According to latest reports, the *AISA I-115* two-seat trainer built for the Spanish Air Force is to be fitted with a de Havilland engine (undisclosed model of the *Gipsy* series). Two hundred of these aircraft have been ordered.

POWER PLANT

• The *Hispano-Suiza Verdon* turbojet has made a 30-hour bench test during which it ran at more than 7,940 lbs. thrust for 24 hours.

• A few months ago SNECMA announced the 101E version of its *SNECMA-ATAR 101* turbojet engine; thrust 7,275 lbs. A new variant, designated the 101E-3, made a certification test early in May at a take-off thrust of 7,720 lbs.

• U.S. Air Force and Convair are examining the possibility of using the *Pratt & Whitney J-75* turbojet in later versions of the Convair F-102 all-weather fighter. With reheat the J-75 delivers approx. 20,000 lbs. take-off static thrust. At present first production models of the F-102 are being fitted with J-57 jets of 14,000 lbs. thrust with afterburner.

EXHIBITIONS—CONGRESSES

• The fifty firms of the French accessories industry whose products are shown at the permanent aviation accessories exhibition organized by *SOPEMEA (Société pour le Perfectionnement des Matériels d'Equipement Aéronautique, Paris)*, held their first official reception of representatives of the trade press on June 3rd. Two further visits to the exhibition were organized for members of N.A.T.O.'s Secretariat General and national representatives attached to the North Atlantic Council, and for the representatives of the aircraft industry of a number of non-N.A.T.O. countries.

• The *Institution of Production Engineers*, London, is holding the first British "Production Exhibition and Conference" at National Hall, Olympia, London from July 7th to 14th, 1954. Exhibitors will include the Department of Scientific and Industrial Research, the British Standards Institution, the Ministry of Supply, as well as private firms.

Book Reviews

Manuel de Droit Aérien — Droit Public. By Marcel Le Goff. Librairie Dalloz, Paris 1954 (French, 513 pages).

Professor Le Goff needs no introduction. During his long experience of air law his literary activity has been considerable. His new handbook on public air law (international and administrative law are his special fields) is based on his earlier work (1934 and 1939), but gives a completely new comprehensive picture of his subject. Le Goff's activity is both theoretical and practical : he teaches at the *Institut des Hautes Etudes Internationales* and the French Staff College and is at the same time a practical lawyer in commercial life, so that he handles all problems from the practical side. It is therefore not surprising that he strenuously advocates a reduction in the present exaggerated sovereignty demands, the freeing of air transport from the crippling bonds of police, customs and immigration regulations.—This is not to say that the book is a " popular " one. The 18-page bibliography alone proves the contrary. He.

The Observers Book of Aircraft (2nd edition). By William Green and Gerald Pollinger. Frederick Warne & Co., Ltd., London and New York 1953 (English, 287 pages. Price 5 shillings).

A handy little type book (" Jane's " in vest pocket size) which gives brief descriptions of 171 modern aircraft of all lands with 284 illustrations. Each aircraft has a picture, three-view drawing and its most important data. Contents are classified according to nature of power plant : jet aircraft, piston-engined aircraft, rotary-wing aircraft. Highly recommendable as a rapid source of information. He.

We Flew to Christchurch—The Story of a Memorable Long Distance Flight. By Henrik Scholte. Published by K.L.M., The Hague 1954 (English, 92 pages).

This entertainingly written book gives a graphic description of the London to Christchurch, New Zealand air race run in the autumn of 1953. It tells why the K.L.M. Douglas DC-6A *Liftmaster* took part in the race and how, captained by H.A.A. Kooper, it emerged victorious in the transport class. " We Flew to Christchurch " is an important document in modern air transport. He.

BOOKS RECEIVED

Publications scientifiques et techniques du Ministère de l'Air.—Distributed by the Service de documentation et d'information technique de l'Aéronautique, Paris :
No. 288. *Essai sur la convection naturelle,* by Pierre Vernotte.
No. 290. *Contribution à l'étude de la déformation plastique,* by Bernard Jaoul.

*

Wiener Geographische Studien, edited by Professor Dr. Herman Leiter.—No. 22 with article on " World Air Transport ".—Verlag Freytag-Berndt und Artaria, Vienna VII.

*

L'étoile, les Ailes et la Couronne, by Bernard Duperier.—Robert Laffont, Paris 1954.

*

Les Fusées, by Hans K. Kaiser ; French translation of the German original (German title " Kleine Raketenkunde ").—Amiot-Dumont, Paris 1954.

Rapport de la deuxième réunion régionale de navigation aérienne Afrique-Océan Indien, Santa Cruz de Teneriffe, November-December 1953. — Doc. 7454, AFL/II (replaces Doc. 7433 to 7438).

Rapport du conseil à l'assemblée sur les activités de l'organisation en 1953 (Assembly—eighth session, documentation). — Doc. 7456, A8-P/2.

Perception de droits pour l'utilisation des aéroports internationaux. — Doc. 7462-C/870.

Division des télécommunications ; Rapport de la cinquième session, Montreal, March 9th to April 9th, 1954. — Doc. 7480-COM/548.

No. B.S.T.116 — *Contribution à l'étude de la transmission infrarouge de la basse atmosphère,* by Pierre Barchewitz, Gilbert Amat and Colette Rossetti.

National Aeronautical Establishment, Ottawa, Canada. — Some problems in Canadian Aeronautical Research and Development, by D.C. MacPhail.

Thermopropulsion des avions. — Turbines et compresseurs axiaux, by René Bidard. — Gauthier-Villars, Paris 1954 ; price 3,900 francs.

Fünfzig Jahre Fliegerei, by Hugo Hooftman. — ARTI, Alkmaar (Holland) 1953 ; price Fl. 2.50 (four languages : Dutch, French, English and German).

The Mind of Mr. Reader...

Fido... versus Fog

Dear Sir,

Interavia No. 4, 1954 includes a brief article on a process developed by the firm of Dalmar, Milan, for dispersing fog at airports in the Po Valley. In this article Fido is described as a " system invented by the British during the war ".

I should like to inform you that I developed and tested a similar fog dispersal system as early as 1937, when I was working at the German Aeronautical Research Institute (D.V.L.), Berlin-Adlershof. A report on this work, entitled " *Fog Dispersal on Airfield Runways* " appeared in the 1939 edition of the German aeronautical research annual. The invention was therefore basically a German one, though it was used only by the Allies during the war. To my knowledge this happened for the first time during the Allied landings in France—in June 1944—at British airfields...

Finally I should like to point out that a considerable advantage of the system I proposed and tested over later fog dispersal methods was that the heated air was blown *horizontally* along the runway. This created a fog-free volume of air which was spread out in all directions by the wind.

Tests showed clearly that this heated air, driven horizontally along, did not immediately rise, but first moved along the ground, creating a large fog-free area in the direction of an approaching aircraft.

Bad Orb (Spessart) — Dr. Theodor Benecke, Physicist

The Editors have meanwhile studied the D.V.L. report mentioned by Dr. Benecke. Apart from the question of fog dispersal at airfields, it also describes the causes of fog and its physical characteristics (with bibliography). The report will be discussed in greater detail at the next opportunity, for fog is still flying's enemy No. 1.

Bouquet from the literary world...

Dear Sir,

You will probably be surprised to receive my letter : I am by no means a specialist in aviation... But in the limited leisure remaining to me from my exacting professional preoccupations (I write books) I endeavour to keep in touch with the activity of the twentieth century—activity which, despite its exasperating or disquieting aspects, is grandiose and inspiring taken as a whole.

Anyone inquiring into contemporary discoveries soon comes upon aviation... One of my friends has just lent me No. 2 (Volume IX) of *Interavia.* Here is a publication which, without ever sacrificing technical values, succeeds in remaining accessible to the " man in the street ". How rare that is today ! Too many articles make science appear dry and complicated. The articles in *Interavia* are written in clear and simple language, with a refreshing spice of humour. Your editors, while fully cognizant of the problems and realities of present-day aviation, have complete command of the French language. Why is it that some of us insist that the Swiss do not handle the French language with the same facility as their neighbours in France ?

This is not a letter from somebody who is asking for something (I know how often this is done in the literary world !). I am not planning to write on aviation and do not even think I shall have the leisure to read your fine Review again for some time. I am simply a professional writer wishing to raise my hat to my colleagues.

Paris — H. Queffelec

Photo credits : Front cover : W. Mahrer, Geneva ; pp. 415-416 : U.S.A.F. (2), ATP (1), Daily Express, London (1) ; pp. 417 - 418 : Interavia records ; pp. 419-422 : ATP (3), S.H.A.P.E. (5) ; pp. 423-425 : Interavia records ; pp. 426-427 : British Crown Copyright (ATP) ; p. 430 : ATP (4), U.S.A.F. (1), U.S. Marine Corps (1) ; pp. 434-437 : ATP (4), Samson-Clark (1), U.S. Navy (1), author (1), factory photos (3) ; pp. 438-442 : factory photos (10), Interavia records (7) ; pp. 443-445 : factory photos ; p. 446 : factory photos ; pp. 447-449 : author ; p. 450 : Interavia records ; p. 451 : E.E. Warburg, London ; pp. 452-453 : N.A.T.O. (1), E.E. Warburg (1), factory photos (6).

ITALIA ASSOCIAZIONE IMPRESE AERONAUTICHE **A.I.A**

ROMA — PIAZZA DELL'ESEDRA N° 47

Free association of Italian aircraft, engine, accessories and equipment industries.

MEMBER COMPANIES

AIRCRAFT AND ENGINES

— AERFER Officine di Pomigliano per Costruzioni Aeronautiche e Ferroviarie — S.p.A. Napoli, Corso Umberto I, 22
— AERO CAPRONI TRENTO S.p.A. — Trento Casella Postale 226
— AERONAUTICA MACCHI S.p.A. — Varese, Via Sanvito Silvestro 80
— ALFA ROMEO S.p.A. — Milano, Via M.U. Traiano 33
— CANTIERI RIUNITI DELL'ADRIATICO S.p.A. — Trieste, Corso Cavour 1
— CAPRONI VIZZOLA S.p.A. — Vizzola Ticino (Gallarate)
— COSTRUZIONI AERONAUTICHE GIOVANNI AGUSTA — Cascina Costa (Gallarate)
— FABBRICA AUTOMOBILI ISOTTA FRASCHINI S.p.A. — Milano, Via Monterosa 89
— FIAT S.p.A. — Torino, Corso IV Novembre 300
— INDUSTRIE MECCANICHE AERONAUTICHE MERIDIONALI S.p.A. — Napoli, Corso Malta 30
— NARDI Costruzioni Aeronautiche S.p.A. — Milano, Aeroporto Forlanini
— NUOVE REGGIANE OFFICINE MECCANICHE ITALIANE S.p.A. — Reggio Emilia
— OFFICINE AERONAVALI VENEZIA S.p.A. — Venezia Lido
— PIAGGIO & C. S.p.A. — Genova, Via A. Cecchi 6
— S.A.C.A. — SOCIETÀ per AZIONI COSTRUZIONI AERONAVALI — Brindisi, Casella Postale 95
— SOCIETÀ AERONAUTICA ITALIANA ING. A. AMBROSINI & C. S.p.A. — Milano, Viale Maino 23
— S.I.A.I. — MARCHETTI S.p.A. — Sesto Calende (Varese)

ACCESSORIES AND EQUIPMENT

— AEREA S.p.A. — Milano, Via Silvio Pellico 12
— AEROSTATICA S.a.r.l. — Roma, Via in Lucina 15
— CARLO BORRANI S.p.A. — Milano, Via Ugo Bassi 9
— COSTRUZIONI ELETTROFERROVIARIE TELECOMUNICAZIONI EDILI FORNITURE — CETEF — di G. Pozzola Roma, Via dei Ciceri 69
— ERCOLE MARELLI S.p.A. — Milano, Casella Postale 3695
— ESSO servizio Aviazione — Roma, Via Bissolati 23
— F.A.C.E. — Fabbrica Apparecchiature per Comunicazioni Elettriche S.p.A. — Roma, Via Emilia 86
— FABBRICA ITALIANA MAGNETI MARELLI S.p.A. — Milano, Casella Postale 3400
— FILOTECNICA SALMOIRAGHI S.p.A. — Milano, Via R. Sanzio 5
— FRANCESCO RABOTTI S.p.A. — Torino, Corso Stupinigi 30
— MICROTECNICA S.p.A. — Torino, Via Madama Cristina 149
— OFFICINE MECCANICHE TAMO SALVA S.a.r.l. — Milano, Via Valtorta 9
— OFFICINE MECCANICHE ZANZI S.p.A. — Ivrea, Via Zanzi 1
— OLEODINAMICA MAGNAGHI S.p.A. — Milano, Via Stamira d'Ancona 27
— OTTICO MECCANICA ITALIANA E RILEVAMENTI AEROFOTOGRAMMETRICI S.p.A. — Roma, Via della Vasca Navale 81
— PIRELLI S.p.A. — Milano, Viale Abruzzi 95
— RIV — OFFICINE DI VILLAR PEROSA S.p.A. — Torino, Corso Vittorio Emanuele II, 8
— SECONDO MONA S.p.A. — Somma Lombardo
— SHELL ITALIANA SERVIZIO AVIAZIONE — Roma, Piazza Augusto Imperatore 32

8

NATO bases are equipped with A.D.B. airport lighting equipments

☆

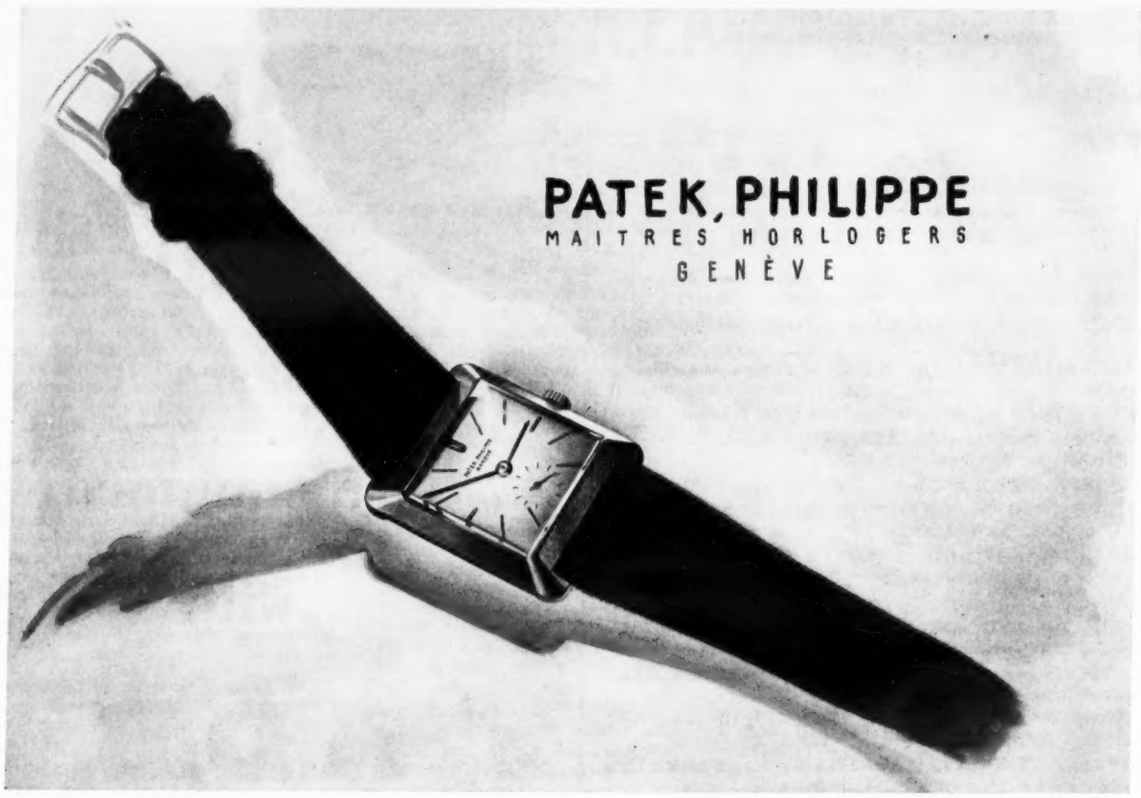
A.D.B. AIR EQUIPMENT S.A.

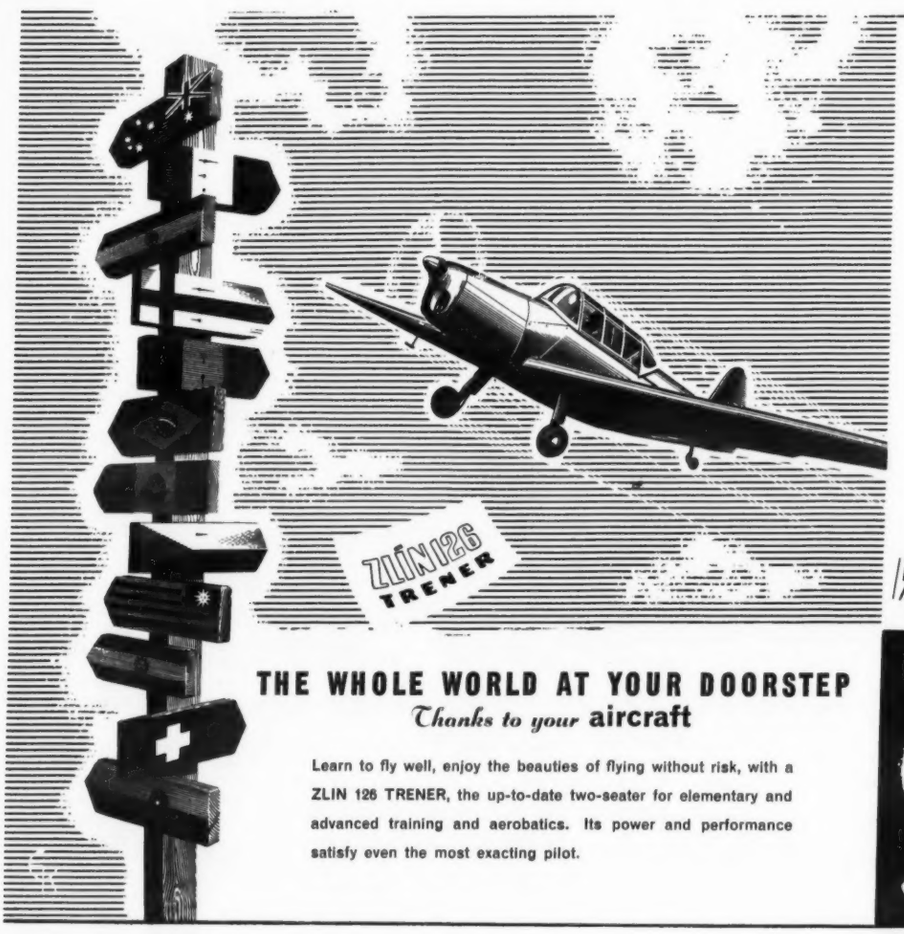
Surveys - Estimates

60, rue Fernand Séverin

BRUSSELS (Belgium)

High and low intensity runway lights, taxi-lights and approach lighting — Constant current regulators for series system — Illuminated wind tees — Control desks — Obstruction and Hazard lights — Radio controlled brightness of runway lights from the plane.





THE WHOLE WORLD AT YOUR DOORSTEP

Thanks to your **aircraft**

Learn to fly well, enjoy the beauties of flying without risk, with a ZLIN 126 TRENER, the up-to-date two-seater for elementary and advanced training and aerobatics. Its power and performance satisfy even the most exacting pilot.

The ZLIN 126 TRENER is fitted with a

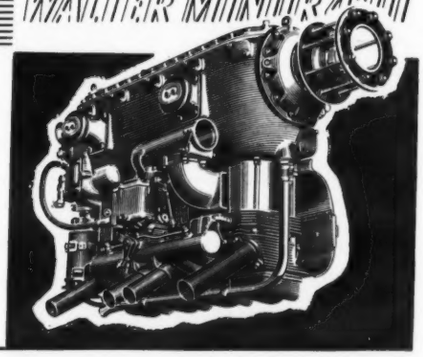
WALTER MINOR 4-III engine,

four cylinders in line, air-cooled, providing everything in the way of safety, long life, economy of operation and simplicity of maintenance that can be wished for from a modern power plant.

MOTOKOV

PRAGUE - CZECHOSLOVAKIA

WALTER MINOR 4-III

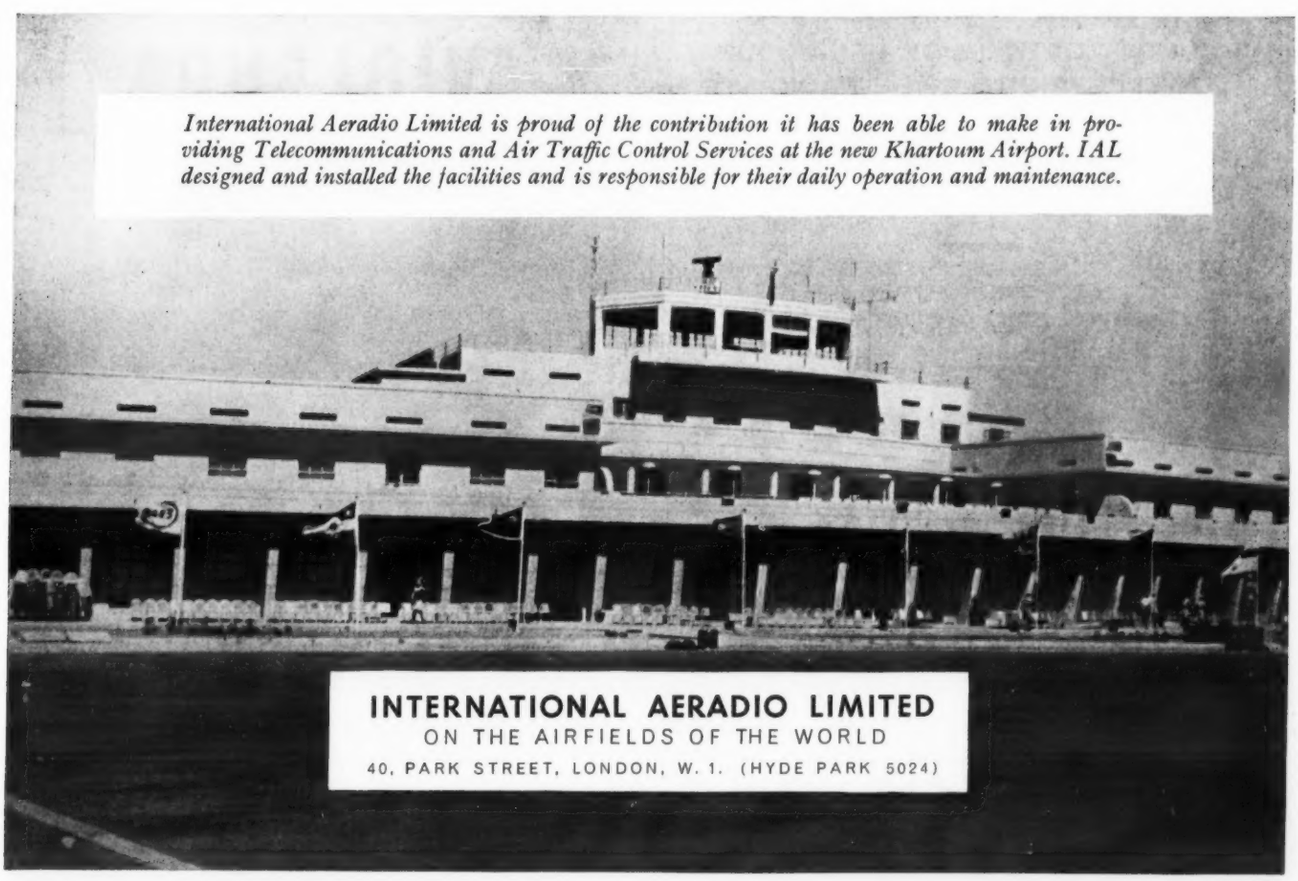


SNECMA

POWER PLANT FOR AIRCRAFT

SOCIÉTÉ NATIONALE
D'ÉTUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION
150, Bd HAUSSMANN · PARIS 8e

International Aeradio Limited is proud of the contribution it has been able to make in providing Telecommunications and Air Traffic Control Services at the new Khartoum Airport. IAL designed and installed the facilities and is responsible for their daily operation and maintenance.



INTERNATIONAL AERADIO LIMITED
ON THE AIRFIELDS OF THE WORLD
40, PARK STREET, LONDON, W. 1. (HYDE PARK 5024)

By

DC-6B

ALITALIA

with pressurized, sound-proofed, air-conditioned cabin

Cruising speed 320 m. p. h.

Lounge chairs
Sleepers

From ROME to BUENOS AIRES
via Lisbon-Rio de Janeiro-Sao Paulo
in 28 FLYING HOURS

Information and reservations from your own travel agency or from :

ALITALIA

ROME : 15, Via L. Bissolati
Tel. 470.242

MILAN : 6, Via G. Verdi
Tel. 877.10

SYMBOL OF QUALITY

RUBBER
PRODUCTS
FOR
AIRCRAFT

AIRCRAFT TYRES
WING DE-ICERS
PROPELLER DE-ICERS
RUBBER WINDOW SEALS
PNEUMATIC RUBBER JOINTING

Kléber-Colombes 9 RUE DE PRESBOURG, PARIS 16e · KLE. 01-00

SOCIÉTÉ D'OPTIQUE, DE MÉCANIQUE, D'ÉLECTRICITÉ ET DE RADIO

O.M.E.R.A.

ELECTRONIC EQUIPMENT
PRECISION OPTICS AND MECHANICS

Airborne VHF transmitter-receivers
SARAM - 5-52

Camera-guns
SEPHOT - Type 20

Cameras
SEPHOT - Type 10 and Type 11

49, rue FERDINAND-BERTHOUD
ARGENTEUIL (S.-&-O.)
TELEPHONE : ARGENTEUIL 04-68 and 18-88

AVIOLANDA

MIJ VOOR VLIEGTUIGBOUW N. V.
PAPENDRECHT AND DORDRECHT
HOLLAND

BUILDING UNDER LICENSE : HAWKER "HUNTER"

*

OVERHAUL, MAINTENANCE AND REPAIR OF AIRCRAFT FOR THE ROYAL NETHERLANDS AIR FORCE, THE ROYAL NETHERLANDS NAVY AND OTHER AIR FORCES AND CIVIL AIRLINES IN THE WORLD

JET ENGINES

ROLLS-ROYCE

- DERWENT - AVON -

FABRIQUE NATIONALE D'ARMES DE GUERRE S.A. - HERSTAL

BELGIUM

F 90

The fire control equipment for 90 mm NATO anti-aircraft batteries

Made by:

CONTRAVES ITALIANA S.p.A.

ROME

LUNGOTEVERE DELLE ARMI, 12 - TEL. 3 08 46

PLANT: VIA TIBURTINA, 965 - TEL. 49 98 48

- Cable for electric and radio wiring
- Coaxial cables
- Armoured wire and cable
- Copper sheathing and braid
- Compensation cables
- Multiple cables

All our cable and wire is officially approved

Limited Liability Company Capitalized at Fr. Frs. 50,000,000
296, Avenue Henri-Barbusse, DRAVEIL (S.-&-O.), France
Telephone : Belle-Épine 55-87

PUBL. RAPY

Here's why it's smart to fly

LAI **LINEE AEREE ITALIANE**

from Italy to : Egypt – France – Germany – Greece – Ireland – Israel – Spain – Switzerland – Tunis – Turkey – U.S.A. and v.v.

Dependable Douglas DC-6's and Convair Liners with pressurized cabins for your comfort at fair-weather altitudes.

DE LUXE and TOURIST CLASS SERVICES

FINEST PLANES
FASTEST SERVICES
THE MOST EXPERIENCED CREWS

See your Travel Agent or

LAI

In Switzerland : ***Swissair***

SOCIÉTÉ D'APPLICATIONS RADIOÉLECTRIQUES A L'AÉRONAUTIQUE ET LA MARINE

S. A. R. A. M.

Radio-electrical Research
Aircraft Receivers and Transmitters
VHF
Types 5-41 - 5-42 - 5-52
UHF

9 & 11, rue H.-G. Fontaine, ASNIÈRES (Seine), France
Telephone : GREsillons 33-21 and 33-22

B.B.H.

BREDA - BERETTA - HISPANO SUIZA

Piazza S.S. Apostoli 73 - Rome

Manufacture in Italy of
HISPANO SUIZA ARMS
—air-borne and anti-aircraft—
under licence from
" Brevets Aéro-Mécaniques " Geneva

Società Aeronautica Italiana **ING. ANGELO AMBROSINI & Co.**

is engaged in quantity production of the

AMBROSINI F.7 "RONDONE 2"

three-seater personal touring aircraft. Top speed 146 m.p.h. (235 km/h) ; cruising speed 125 m.p.h. (200 km/h ; fuel consumption, 25 miles per U.S.gal. (9 lit. per 100 km)

VIBRACHOC

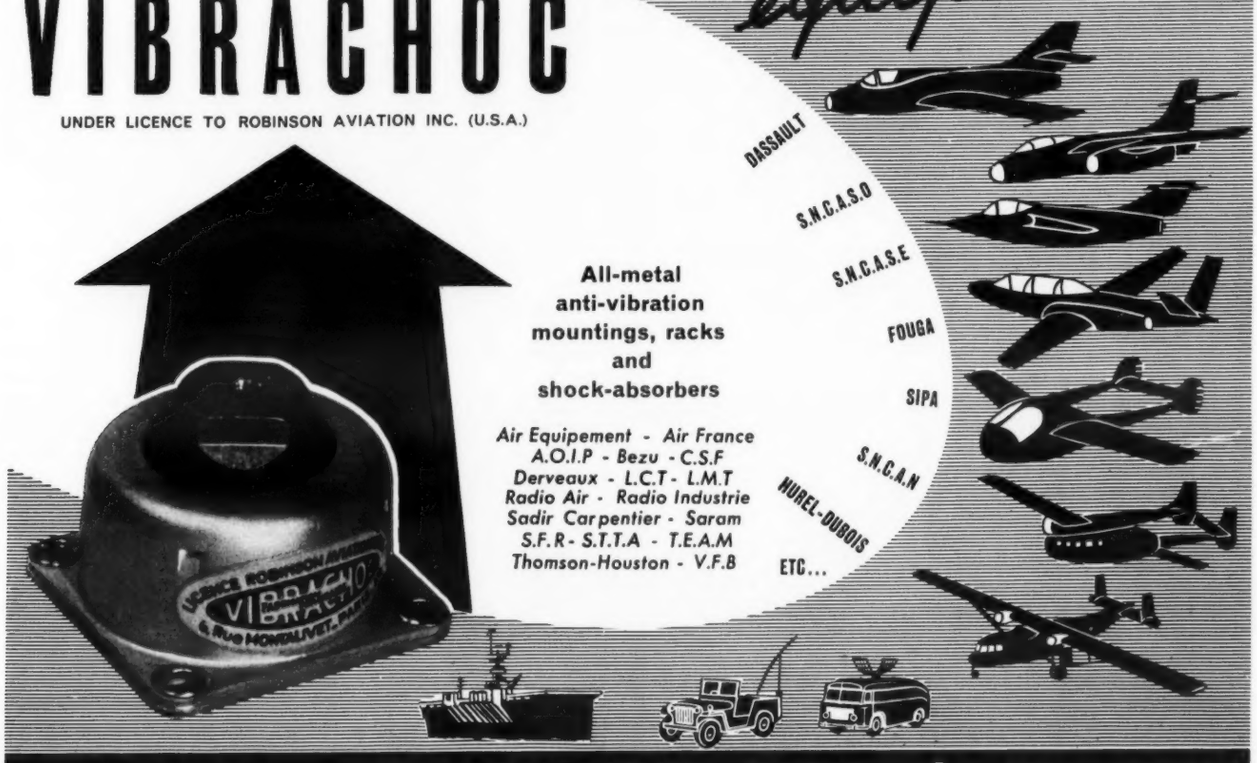
UNDER LICENCE TO ROBINSON AVIATION INC. (U.S.A.)

All-metal anti-vibration mountings, racks and shock-absorbers

Air Equipement - Air France
A.O.I.P - Bezu - C.S.F
Derveaux - L.C.T - L.M.T
Radio Air - Radio Industrie
Sadir Carpentier - Saram
S.F.R - S.T.T.A - T.E.A.M
Thomson-Houston - V.F.B

équipe

DASSAULT
S.N.C.A.S.O
S.N.C.A.S.E
FOUGA
SIPA
S.N.C.A.N
NUREL-DUBOIS
ETC...



VIBRACHOC · 6 RUE MONTALIVET · PARIS · TÉL. ANJ. 05-55

NISTRI
OMI
ROMA

OTTICO MECCANICA ITALIANA
E RILEVAMENTI AEROFOTOGRAMMETRICI
S. p. Az.

Aircraft instruments for navigation and engine checking
Aerial cameras
Aerial survey cameras and rectifiers

Head office and plant
ROME : Via della Vasca Navale, 81
Branch in PARMA

SFENA

SOCIÉTÉ FRANÇAISE D'ÉQUIPEMENTS POUR LA NAVIGATION AÉRIENNE
25 to 29, rue du Pont - Neuilly (Seine)

EQUIPMENT DEPARTMENT
Gyroscopic horizons
Directional gyros
Magnetic compasses
Navigation equipment
Automatic pilots
Control for guided missiles
Servo-motors

ELECTRONIC DEPARTMENT
Remote control and measuring equipment
Communications Transmitter-Receiver
Light VHF equipment
Panoramic Receiver
VHF equipment

OFFICINE AERONAVALI

AIRCRAFT PRODUCTION AND REPAIR

ST. NICOLO AIRPORT LIDO-VENICE
(ITALY)

"Textiglass" LEADS IN THE FIELD OF PLASTIC MATERIAL REINFORCEMENT

The **VAUTOUR** incorporates eight essential non-stressed **TEXTIGLASS**-reinforced airframe components.

"Textiglass" EXPERIENCE COVERS THE WIDEST AND MOST VARIED FIELD

"Textiglass" GUARANTEES GOOD ENGINEERING AND HIGH QUALITY

"Textiglass" guarantees the engineering results obtained by its use as a reinforcing material in each individual case
— has standardized its products
— offers its seasoned advice to its customers
— investigates all problems arising in its shops and research laboratories
— is familiar with the surface finish treatment appropriate to each case.

"Textiglass"

"TEXTIGLASS"
glass fabric for the reinforcement of plastics is at your disposal to help you solve your problems.
LITERATURE AND SAMPLES UPON REQUEST

TISSAGE FRANÇAIS
Pierre GENIN & Cie S. A.
LYONS - FRANCE
SALES DEPARTMENT :
44, rue Paul-Valéry, Paris 16e
Telephone : PAS. 13-91 (three lines)
U.S. PRODUCING MILLS
CHENEY BROTHERS
MANCHESTER, Conn., U.S.A.
SALES OFFICES :
92, Liberty Street, New York 6 (N.Y.)

EQUIPMENT FOR THE TRANSPORT OF GOODS
by helicopter and aircraft
HEAVY PARACHUTE DROPPING
SIREN
Suppliers to the French airborne forces

Head Office
43, rue d'Angiviller
VERSAILLES

Design Office
13, rue St. Honoré
VERSAILLES

Wind tunnel balances of highest precision for all types of wind tunnel with remote reading and recording.

Transonic test sections continuously and accurately adjustable up to Mach 1.8. Minimum tunnel wall influence even in sonic range. Low power requirements.

Supersonic test sections, Mach number continuously and accurately adjustable. Models for up to Mach 3.5.

Precision instruments for fluid research and related purposes.

Research and development contracts.

Dr.-Ing. G. DÄTWYLER and INGENIEUR-BÜRO HAUSAMMANN
171 Dufourstrasse **ZURICH 8 (Switzerland)**

PILATUS

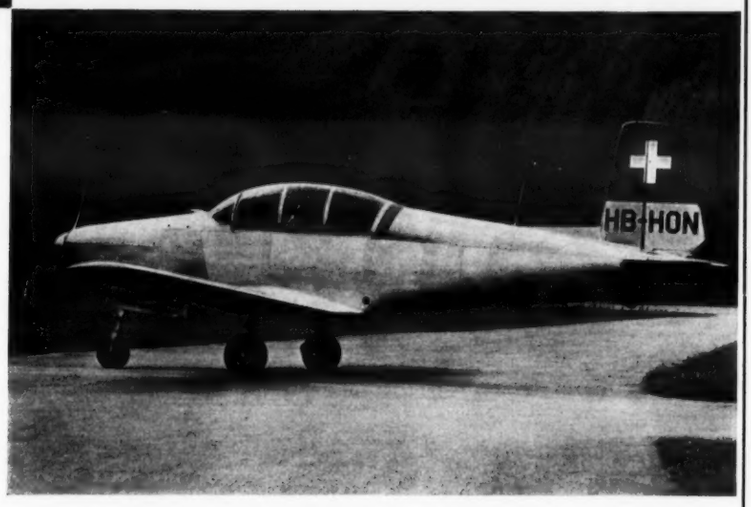
PILATUS AIRCRAFT WORKS LTD., STANS (SWITZERLAND)

TELEPHONE (041) 84 14 46

Design and production of civil and military aircraft
Production of spares etc.
Repairs and inspections

PILATUS-AIR-SERVICE

Technical maintenance, overhauls, inspection, repairs and ground handling.



GENÈVE-COINTRIN, TEL. (022) 33 53 65 - ZURICH-KLOTEN, TEL. (051) 93 73 87

POTEZ 75

GROUND SUPPORT AIRCRAFT

450 H. P. POTEZ 8 D ENGINE

SOCIÉTÉ DES AVIONS ET MOTEURS HENRY POTEZ

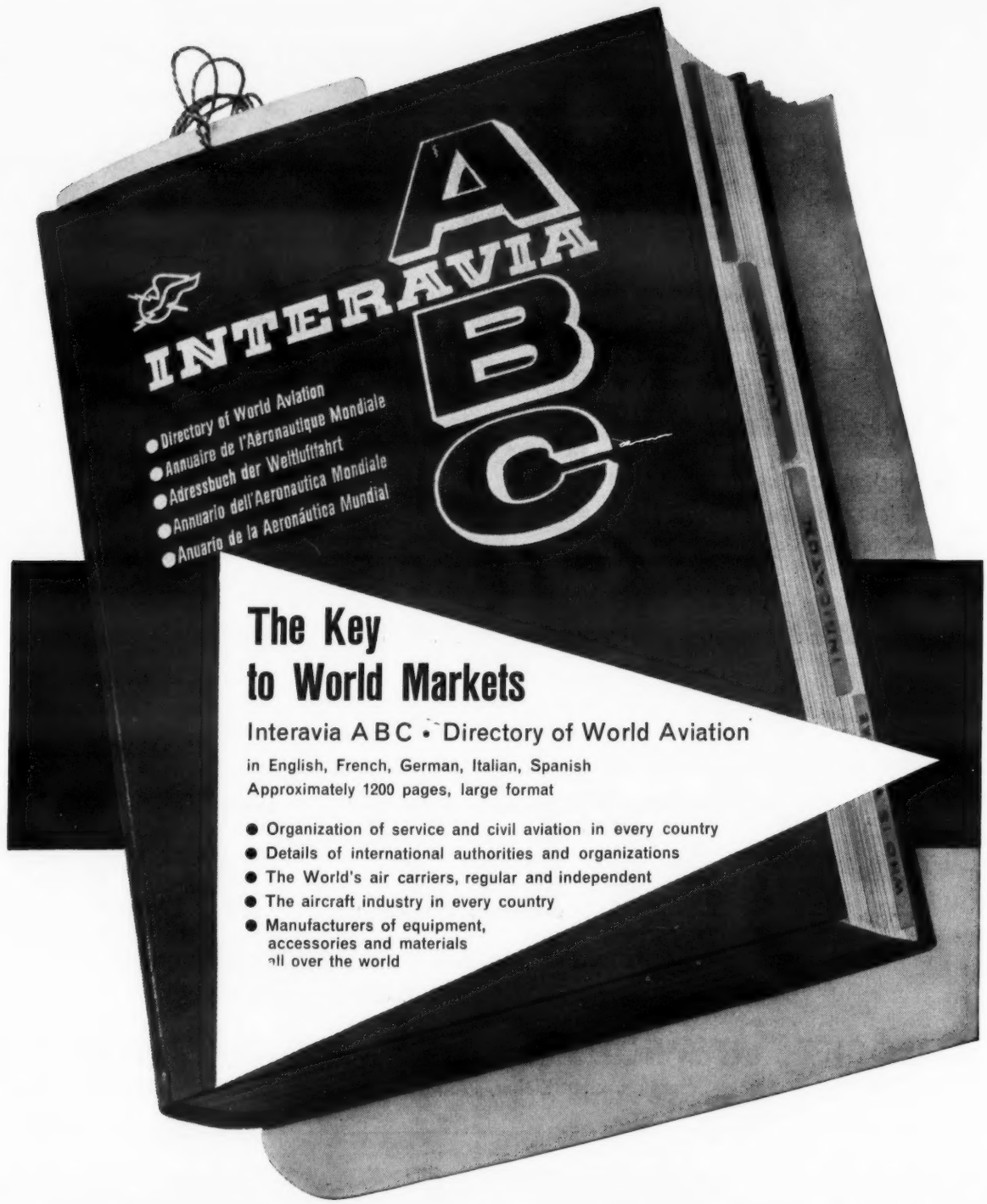
Kléber 27-83 — 46, avenue Kléber, PARIS XVI[e] — POTEZAERO-PARIS

» Rolstarter «

STRÜVER ENERGIZERS

for all types of aircraft

AD. STRÜVER GMBH AGGREGATEBAU HAMBURG


INTERAVIA
A
B
C
● Directory of World Aviation
● Annuaire de l'Aéronautique Mondiale
● Adressbuch der Weltluftfahrt
● Annuario dell'Aeronautica Mondiale
● Anuario de la Aeronáutica Mundial
The Key
to World Markets
Interavia A B C • Directory of World Aviation
in English, French, German, Italian, Spanish
Approximately 1200 pages, large format
● Organization of service and civil aviation in every country
● Details of international authorities and organizations
● The World's air carriers, regular and independent
● The aircraft industry in every country
● Manufacturers of equipment, accessories and materials all over the world

The only complete reference book on world aviation

NEW, ENLARGED 1955 EDITION READY NEXT AUTUMN

ORDER NOW FROM :

INTERAVIA, GENEVA 11, SWITZERLAND
and through Interavia's agents or any bookseller

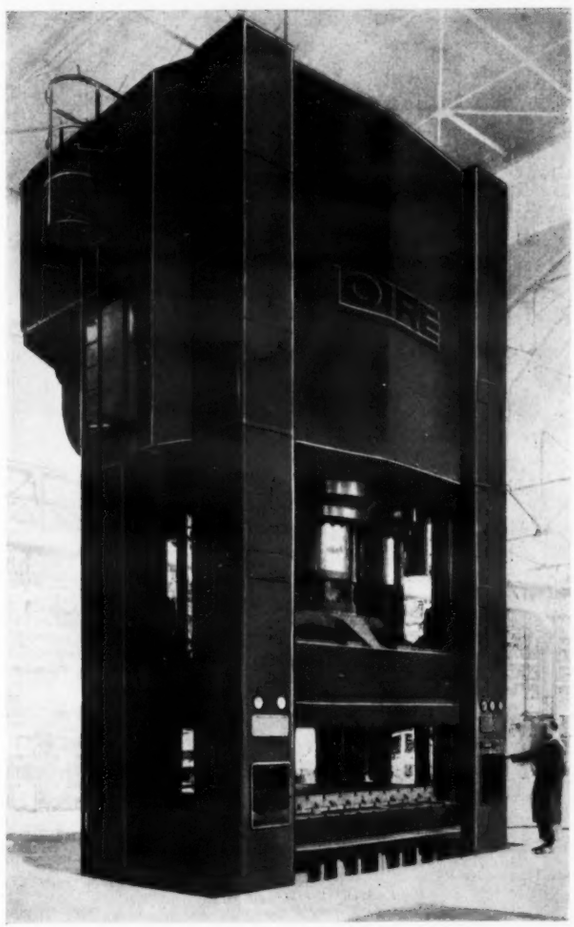
LIST OF ADVERTISERS IN INTERAVIA No. 7, 1954

	Page
Aeronautica Macchi S.p.Az., Varese	466
Air Equipement, Asnières	403
Air France, Paris	400
Alitalia, Rome	458
S.A.I. Ambrosini & C., Milan	461
Associazione Imprese Aeronautiche, Rome	455
Aviolanda N.V., Papendrecht	458
Backer, A. de, Air Equipment S.A., Brussels	455
Breda-Berretta-Hispano Suiza, Rome	460
Canadair Ltd., Montreal	401
Collins Radio Co., Cedar Rapids	399
Contraves Italiana S.p.A., Rome	459
Dätwyler, Dr. Ing. G., Zurich	462
Douglas Aircraft Co., Inc., Santa Monica	409
Dunlop Rubber Co., Coventry	408
English Electric Co. Ltd., London	413
Esso Export Corp., New York	468
EST, Compagnia, Rome	410
Fabrique Nationale d'Armes de Guerre, Herstal-Liége	459
Fiat S.p.Az., Turin	405
Filotex, Draveil (S.-&-O)	460
Fokker, N.V. Koninklijke Nederlandse Vliegtuigenfabriek, Amsterdam	411
Fouga, Paris	390-391
Gilfillan Bros., Los Angeles	392-393
Grevos N.V., Rotterdam	466
Hurel-Dubois, Avions, Paris	407
Iberia, Líneas Aéreas Españolas, Madrid	460
International Aeradio Ltd., London	457
Kléber-Colombes, Paris	458
Linee Aeree Italiane, Rome	460
Lockheed Aircraft Corp., Burbank	396-397
Loire, Ateliers et Chantier de la, Paris	465
Motokov, Prague	456
New York Air Brake Co., New York	395
Officine Aeronavali S.p.A., Venice	462
Officine di Pomigliano per Costruzioni Aeronautiche e Ferroviarie (AERFER), Naples	402
OMERA, Paris	458
Ottico Meccanica Italiana, Rome	462
Patek, Philippe & Co., Geneva	456
Philips Telecommunicatie Industrie, Hilversum	412
Pilatus Aircraft Works, Stans	463
Potez, Société des Moteurs, Paris	463
Pye Telecommunications Ltd., Cambridge	394
Radio-Schweiz A.G., Berne	466
Roe, A.V., Canada Ltd., Malton (Ontario)	467
Salon de la Technique, Turin	406
S.A.R.A.M., Asnières (Seine)	460
Secondo Mona, S.p.Az., Somma Lombardo	466
S.F.E.N.A., Neuilly (Seine)	462
Siemens-Schuckertwerke A.G., Erlangen	406
SIREN, Versailles	462
S.N.C.A. du Nord, Paris	412
S.N.C.A. du Sud-Ouest, Paris	414
S.N.E.C.M.A., Paris	457
Strüver GmbH., Hamburg	463
Svenska Aeroplan A.B., Linköping	398
Textiglass, S.A. Pierre Genin & Cie., Paris	462
Thomson-Houston, Compagnie Française, Paris	404
Turck, Jean, S.à r.l., Cachan (Seine)	466
Vibrachoc, Paris	461

LOIRE

HIGH PRESSURE
HYDRAULIC EQUIPMENT

PRESSES • PUMPS • ACCUMULATORS



4,500-ton sheet press

ATELIERS & CHANTIERS
DE LA LOIRE

SOCIÉTÉ ANONYME AU CAPITAL DE 1.400.000.000
4, RUE DE TÉHÉRAN, PARIS-8e - CAR 33-51
NANTES - SAINT-NAZAIRE - SAINT-DENIS

European Turco Factory

Chemische Fabriek «Grevos» N. V. Rotterdam, Holland.

N. A. T. O. Air Forces suppliers of :

- **Specialized aircraft metal cleaning, conditioning and maintenance compounds.**
- **Turbine and reciprocating engine parts cleaning and testing procedures.**
- **Qualified specifications products.**

TRAINING AIRCRAFT
ADVANCED STAGE

AERONAUTICA MACCHI S.P.A. VARESE
ITALY
Founded in 1912

RADIO-SWITZERLAND

Limited Company for Wireless Telegraphy and Telephony

MANAGEMENT :
Hauptpostgebäude, Berne. Tel. 2 26 03

SEND YOUR TELEGRAMS

VIA RADIOSUISSE

Direct wireless connections with all parts of the world

Telegrams « Via Radiosuisse » may be handed in at any Swiss telegraph office

Charges are the same as for wire telegrams

Etablissements Jean Turck (S.A.R.L.)

19, rue de la Gare - CACHAN (Seine) - Telephone : ALEsia 31-80 - FRANCE

Remote control and measuring equipment

Radio command systems (Radio-Télé-Commande)
for continuous operation of a control surface or step-by-step control, with protective casing and wiring in series.

Measurement transmitters (Radio-Télé-Mesure)
for simultaneous transmission of 6 values with 1 % margin of error ; coloured graphic recording ;
electronic pick-ups for temperature, pressure, etc.

Detectors and transmitters for infra-red rays ;
glow discharge tubes ; miniature lamps ; flashing lamps ; detectors ; thermo elements ; selective photo-electric cells.

AIRCRAFT ACCESSORIES

MECCANICA AERONAUTICA SECONDO MONA - SOMMA LOMBARDO

SM SECONDO MONA

SOMMA LOMBARDO — 'Phone 23.498
MILAN — 12 Via Galilei — 'Phone 61-634

Printed in Switzerland

nose for trouble

The big black nose of the CF-100—and what's inside it—is truly a mark of distinction. For it identifies the all-weather interceptor from the day fighter and, in the case of the CF-100, as Canada's Aerial Defender against bomber attack across the North.

The "insides", a complex mass of radar and electronic equipment—is designed to guide the CF-100 Mk. 4 unerringly to its target, lock on and destroy it with a formidable armament combination of rockets and guns. The effectiveness of this search and fire-control system is being demonstrated almost nightly during mock interception exercises by R.C.A.F. CF-100 squadrons based at strategic points. With its twin Orendas, also designed and produced by AVRO Canada, the CF-100 Mk. 4 has a greater range and more power than any other fighter-interceptor in service anywhere. The Orenda also powers the Canadair Sabre 5, the outstanding day fighter in service today.

For original aeronautical design, plus efficient production, look to AVRO Canada.

AIRCRAFT DIVISION

A.V. ROE CANADA LIMITED

MALTON, ONTARIO

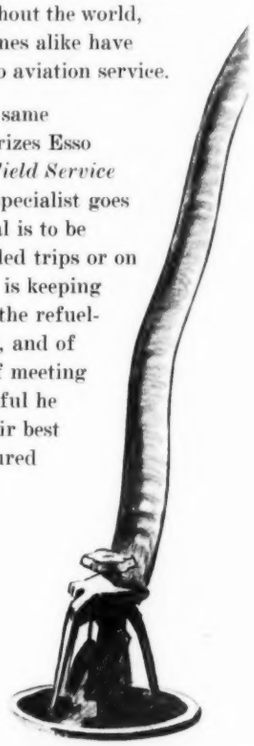
MEMBER OF THE HAWKER SIDDELEY GROUP

the man from Esso...

the field service representative

From Gander to Cairo International . . . from Ministro Pistarini to Orly – at airports throughout the world, operators of private planes and airlines alike have learned to depend on unexcelled Esso aviation service.

Helping Esso Marketers provide the same high quality of service that characterizes Esso aviation fuels and lubricants is the *Field Service Representative.* This well-travelled specialist goes wherever the famed Esso winged oval is to be found. Whether on regularly scheduled trips or on special assignment, his main concern is keeping Esso Marketers constantly aware of the refueling requirements of modern aircraft, and of the *safest* and most efficient ways of meeting these requirements. Just how successful he and Esso Marketers are in giving their best to the aviation industry can be measured by the fact that . . .



of all the world's international airlines . . . 8 out of 10 use

ESSO

AVIATION PRODUCTS